1997

Paleomagnetic investigation of the Lower Cretaceous Kootenai Formation western Montana

Kelly M. Brunt
The University of Montana

Maureen and Mike
MANSFIELD LIBRARY

The University of **MONTANA**

Permission is granted by the author to reproduce this material in its entirety, provided that this material is used for scholarly purposes and is properly cited in published works and reports.

** *Please check "Yes" or "No" and provide signature* **

Yes, I grant permission __X__
No, I do not grant permission ______

Author's Signature [illegible]

Date 5/1/97

Any copying for commercial purposes or financial gain may be undertaken only with the author's explicit consent.

PALEOMAGNETIC INVESTIGATION OF THE LOWER CRETACEOUS KOOTENAI FORMATION, WESTERN MONTANA

By

Kelly M. Brunt

B.S., Syracuse University, 1993

Presented in partial fulfillment of the requirements for the degree of

Master of Science

University of Montana

1997

Approved by

Chairman, Board of Examiners

Dean Graduate School

5-1-97

Date

Brunt, Kelly M., M.S., May, 1997 Geology

PALEOMAGNETIC INVESTIGATION OF THE LOWER CRETACEOUS KOOTENAI FORMATION, WESTERN MONTANA

Director: Steven D. Sheriff SDS

The Lower Cretaceous (Aptian) Kootenai Formation was sampled in two localities of western Montana for a paleomagnetic investigation of a possible rotation of the Purcell Anticlinorium during Laramide deformation in Montana. Eight sites from the Ford Creek locality and three sites from the Marias Pass locality were sampled and subjected to standard paleomagnetic techniques in an attempt to test the rotational model. One site from the Marias Pass locality was rejected as it had a site-mean direction that is coincident with the secondary, present-day, direction of the other two. The two remaining sites of the Marias Pass locality yielded a structurally corrected, characteristic, direction that is seemingly rotated counterclockwise 45±16°, with no latitudinal translation. However, based on only two reliable sites, the statistics from this locality are not very robust. Thus results from the Marias Pass locality were not used to test the extent of the rotational model. Six of the eight sites sampled in the Ford Creek locality passed statistically based arbitrary rejection criteria and were compared with Aptian (108-115 Ma) reference poles in the literature. The sites from this locality have been rotated clockwise 23±9°, with little latitudinal translation. While the results of this locality support previously devised rotational models and are statistically coincident with paleomagnetic results from the Purcell Anticlinorium, it can not be conclusively determined that the Purcell Anticlinorium rotated as a coherent unit clockwise through 23±9°. The extent of the rotation can not be determined based on one reliable locality. While a regional rotation is one possible explanation, another is that the locality has experienced a small scale vertical axis rotation.

TABLE OF CONTENTS

ABSTRACT	ii
LIST OF FIGURES	iv
LIST OF TABLES	v
ACKNOWLEDGMENTS	vi
INTRODUCTION	1
FIELD METHODS	11
LABORATORY TECHNIQUES	13
PALEOMAGNETIC RESULTS	16
DISCUSSION	30
CONCLUSIONS	41
REFERENCES	42
APPENDIX A-THE KOOTENAI FORMATION	47
APPENDIX B-FUTURE STUDIES	49
APPENDIX C-PALEOMAGNETIC DATA	50

LIST OF FIGURES

FIGURE 1 3

FIGURE 2a 8

FIGURE 2b 9

FIGURE 3 10

FIGURE 4a 17

FIGURE 4b 18

FIGURE 5 19

FIGURE 6a 25

FIGURE 6b 26

FIGURE 7 29

FIGURE 8 32

FIGURE 9 39

LIST OF TABLES

TABLE 1 21

TABLE 2 22

TABLE 3 27

TABLE 4 31

TABLE 5 38

Acknowledgments

I would like to graciously thank Dr. Steve Sheriff for a lot of time, advice, patience, and spelling asistense throughout this study. I would also like to thank Dr. Jim Sears and Dr. Jim Jacobs for input and support when it was needed most.

This study was partially financed by the University of Montana in the form of the McDonough Scholarship. Laboratory expenses at the University of New Mexico were financed by grant from Dr. Steve Sheriff. The University of Montana Department of Geology furnished travel funds. Dr. John Geissman and Dr. Roberto Molina-Garza gave much useful advise and assistance in Dr. Geissman's laboratory.

Mental support was offered by Josh Distler and J.J. Snyder. Field support was offered by Steen Simonsen, Mark O'Riordan, Liz Landrigan, Smokey, and Pepper. Computing support was offered by Derek Sjostrom.

Finally, I would like to acknowledge the cogs of the University of Montana Department of Geology: Loreene Skeel and Judy Fitzner.

Introduction

Paleomagnetism is the method used to determine rotations and translations of tectonic plates and terrains (Grubbs and Van der Voo, 1976; Beck, 1980; Schwartz and Van der Voo, 1984; Irving *et al.*, 1986; Eldredge and Van der Voo, 1988; Beck, 1991; Irving and Wynne, 1991; Jolly and Sheriff, 1992; Symons and Timmons, 1992; Wynne *et al.*, 1992; Link *et al.*, 1993; Irving *et al.*, 1996). While techniques prove easier when applying paleomagnetism to igneous rocks, rotational and translational models can also be tested using sedimentary units. Paleomagnetic field and laboratory techniques determine the declination and inclination of the geomagnetic field at the rock's formation. From the direction of the field at that point in time one can determine an instantaneous estimate of a dipole axis known as a virtual geomagnetic pole (VGP). Calculating inclinations and declinations from the measured virtual geomagnetic pole and then comparing that direction from rocks in an allocthonous area with those expected from the average paleopole for a continent yields a measurement of relative rotation and translation. Anomalous inclinations may indicate latitudinal translation. Similarly, differences in declinations may indicate that the terrain has rotated around a nearby vertical axis. This study uses paleomagnetism of the sandstones of the Lower Cretaceous (Aptian) Kootenai Formation (Suttner, 1969; DeCelles, 1986), of western Montana to examine a possible rotation of the Purcell Anticlinorium (Symons and Timmons, 1992; Sears, 1994; Cook and Van der Velden, 1995; Van der Velden and Cook, 1996) within the Rocky Mountain fold and thrust belt.

Many workers have been interested in, and proposed models for, the orogenic development of the Rocky Mountain fold and thrust belt (Smith, 1965; Hoffman *et al.*, 1976; Monger and Price, 1979; Woodward, 1981; Price and Carmichael, 1986; Symons and Timmons, 1992; Link *et al.*, 1993; Sears, 1994; Colpron and Price, 1995; Cook and Van der Velden, 1995; Van der Velden and Cook, 1996). Symons and Timmons (1992), following proprietary work of the Amoco Production Company, proposed a rotational model for the Purcell Anticlinorium (Figure 1). They completed a paleomagnetic study of layered argillites and the Moyie sills of the Middle Proterozoic Prichard Formation within the anticlinorium and compared their declinations to those calculated from the Apparent Polar Wander Path for the Middle Proterozoic (Irving, 1979). Symons and Timmons (1992) concluded that the tectonic history of the Purcell Anticlinorium included, among other structural complexities, a clockwise rotation of 37±12° with little or no latitudinal translation. They proposed that this deviation was caused as the anticlinorium was thrust in a northeasterly direction onto the craton during Laramide deformation at about 72 to 56 Ma (Hoffman *et al.*, 1976). Theirs being the first published paleomagnetic study of a possible rotation of the Purcell Anticlinorium, Symons and Timmons (1992) cited many structural reasons for this apparent rotation. Included in their reasoning was the recognition of a regional north northwest structural trend which, in closer detail, changes to a northern trend within the anticlinorium. The detailed structural mapping of Mudge *et al.* (1982) also indicates this in measured strikes and dips in the vicinity of the anticlinorium. Thus changes in the trend of regional structures

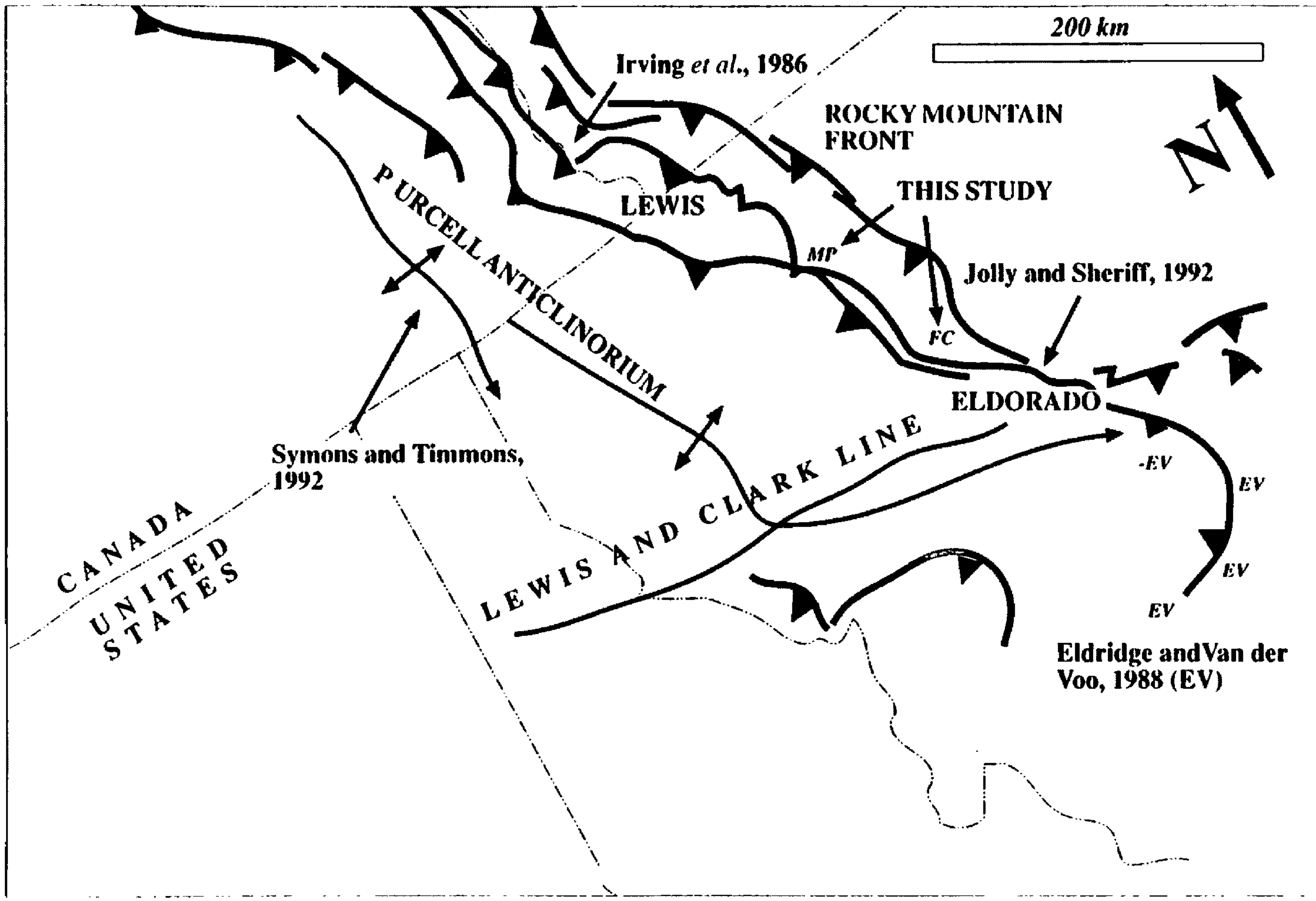


Figure 1. Regional relationship between the two localities of this study area (Ford Creek, FC, and Marias Pass, MP) and four others. Irving et al. (1986) measured a clockwise rotation of 24±10°. Eldredge and Van der Voo (1988) measured clockwise rotations (EV) of 35° in the Helena Salient, 23° in the Southwest Montana Traverse Zone, 54° in the McCarthy Mountain Salient, and a counterclockwise rotation (-EV) of 30° in the Helena Salient. Jolly and Sheriff (1992) measured a counterclockwise rotation of 25.2±14°. Symons and Timmons (1992) measured a clockwise rotation of 37±12°.

seems to indicate the possibility of a rotation similar to the observations of Symons and Timmons (1992).

Link *et al.* (1993), in a review of Proterozoic sedimentary strata of the western Cordillera, examined the Middle Proterozoic Belt Supergroup (Höy, 1989; Ross *et al.*, 1991; Ross *et al.*, 1992; Chamberlain and Doughty, 1993) and compared its paleomagnetic data to those of other synchronological Proterozoic sedimentary units. Link *et al.* (1983) provide a contrary view to that of Symons and Timmons (1992). Because the paleomagnetic pole positions of the Belt units and other Proterozoic units were coincident, Link *et al.* (1993) concluded that the Belt units had not been significantly rotated. The paleopoles of the Belt units were obtained from many different thrust sheets and yield a regional result. While the data indicated no regional rotation of the Belt units, Elston and Bressler (1980) measured declination deviations near thrust sheet margins and concluded that these were only localized vertical axis rotations. Thus the older data reviewed by Link *et al.* (1983) are in conflict with the more recent determination of Symons and Timmons (1992).

More recently Sears (1994) elaborated on rotation models for the development of the Purcell Anticlinorium and the tectonic history of the structure by compiling the results of various structural and geophysical studies. He proposed that the Lewis and Clark line (Smith, 1965; Woodward, 1981), southwest of the anticlinorium, sits on top of a southwest-facing thrust ramp that helped form the anticlinorium as a fault-bend fold. Sears (1994) further implied that the ramp formed at the base of the marginal facies of the system. These marginal facies are now found on the northeast edge of the structure.

Thus the Purcell Anticlinorium was thrust over the ramp. During thrusting, it rotated clockwise 37±12° based on the measurements of Symons and Timmons (1992).

Although much of the strata of the Purcell Anticlinorium is Precambrian, the structure formed during Laramide deformation and units as young as Paleocene are carried on the thrust (Mudge *et al.*, 1982). Several scientists have completed paleomagnetic investigations of Cretaceous aged sedimentary units in the Disturbed Belt of Montana and Alberta, Canada. Irving *et al.* (1986) studied rotations of the Early Cretaceous Crowsnest Formation in Alberta, Canada (Figure 1). Along with a northward translation of 17±6°, they found a clockwise rotation of 24±10° from the expected mid-Cretaceous paleomagnetic direction. Eldredge and Van der Voo (1988) sampled the Lower Cretaceous Kootenai Formation and found clockwise and counterclockwise rotations within salients of western Montana and eastern Idaho (Figure 1). They measured maximum clockwise rotations of 54° in the McCarthy Mountain Salient, 23° in the southwest Montana Traverse Zone, and 35° in the Helena Salient. Eldredge and Van der Voo's (1988) rotations were calculated from a reference pole averaged from two localities they sampled on the stable foreland. Thus Eldredge and Van der Voo (1988) and Irving *et al.* (1986) established the paleomagnetic reliability of Cretaceous-aged sedimentary units in the northern Rocky Mountains and found some rotations coincident with those of Symons and Timmons (1992).

Despite the reliability of sedimentary units and the generally clockwise rotations determined by Eldredge and Van der Voo (1988) and Irving *et al.* (1986), a significant number of counterclockwise rotations within the nose of the Helena salient are also presented by Eldredge and Van der Voo (1988). These include a maximum of 30° of counterclockwise rotation in the Helena Salient. The authors interpret the varying degree and direction of the rotations as noncoherency of the thrust plate due to buttressing from the underlying craton. Northwest of the Helena Salient, and thus northwest of the work of Eldredge and Van der Voo (1988), Jolly and Sheriff (1992) also found counterclockwise rotations of 25.2±14° within the Late Cretaceous Two Medicine Formation near Wolf Creek, Montana (Figure 1). Their results are relative to the Late Cretaceous paleomagnetic reference pole of Gunderson and Sheriff (1991) from the Adel Mountain Volcanics of west central Montana.

Further afield, other studies have also focused on rotations in thrusted units and investigated the interaction between thrust sheets and their underlying rocks. Grubbs and Van der Voo (1976) completed a paleomagnetic study of Triassic units within the Prospect Thrust Sheet of the Idaho-Wyoming Overthrust Belt. Schwartz and Van der Voo (1984) followed up this investigation and added paleomagnetic data from the Lower Cretaceous. They found that the rotations of the Prospect thrust sheet were neither translated nor transmitted to the older, western, Darby and Absaroka thrust sheets. Irving and Wynne (1991) investigated rotations within the Lower Jurassic and Triassic units of the Wrangellia, Stikinia, and Quesnellia terrains of the Canadian Cordillera in British Columbia. Each of these studies reported considerable variance of the paleomagnetically determined rotations.

Given mixed clockwise and counterclockwise rotations (Grubbs and Van der Voo, 1976; Schwartz and Van der Voo, 1984; Eldredge and Van der Voo, 1988; Irving and

Wynne, 1991; Jolly and Sheriff, 1991; Symons and Timmons, 1992) it becomes clear that near the margin of the thrust sheet, regional rotations may be masked by small scale vertical axis rotations. To test models of regional rotation requires a regional distribution of paleomagnetic data. This is particularly true when one considers the rotational models of Symons and Timmons (1992) and Sears (1994). To further test and substantiate the observations of Symons and Timmons (1992), with respect to local versus regional rotations, I conducted a paleomagnetic investigation of Cretaceous aged units, thrust with the Purcell Anticlinorium, at two localities approximately 100 km apart. The two localities, named Ford Creek (Figures 2a) and Marias Pass (Figure 2b), are within the Aptian (108-115 Ma) Lower Cretaceous Kootenai Formation (Figure 3) (Suttner, 1969; DeCelles, 1986). Ford Creek is 100 km north of the Helena Salient and the Lewis and Clark Line. The Marias Pass locality, just south of Glacier National Park, was chosen 100 km further north to investigate the possible coherency of the rotation.

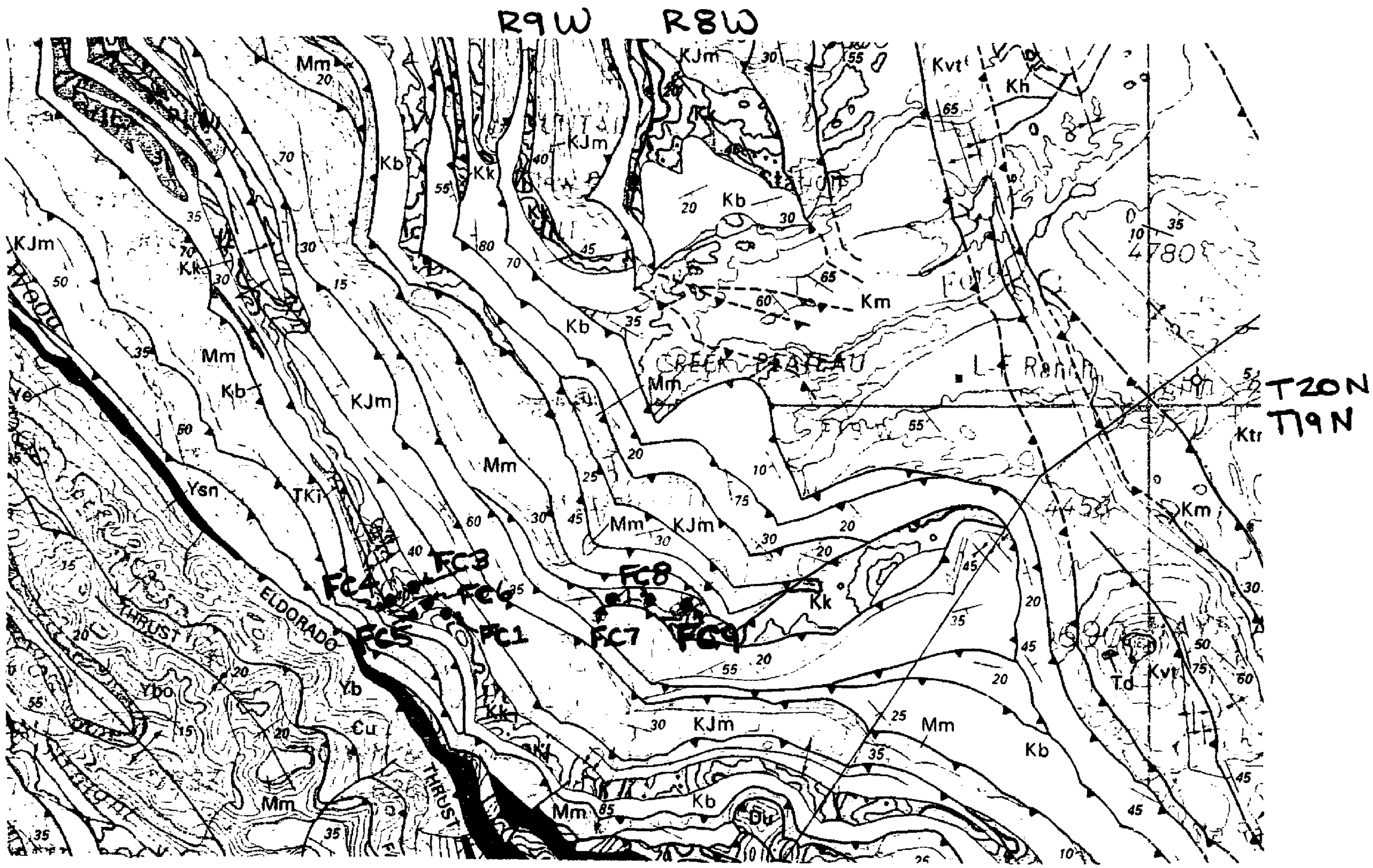


Figure 2a. Geologic map of the Ford Creek locality. (Mudge, *et al.*, 1982)

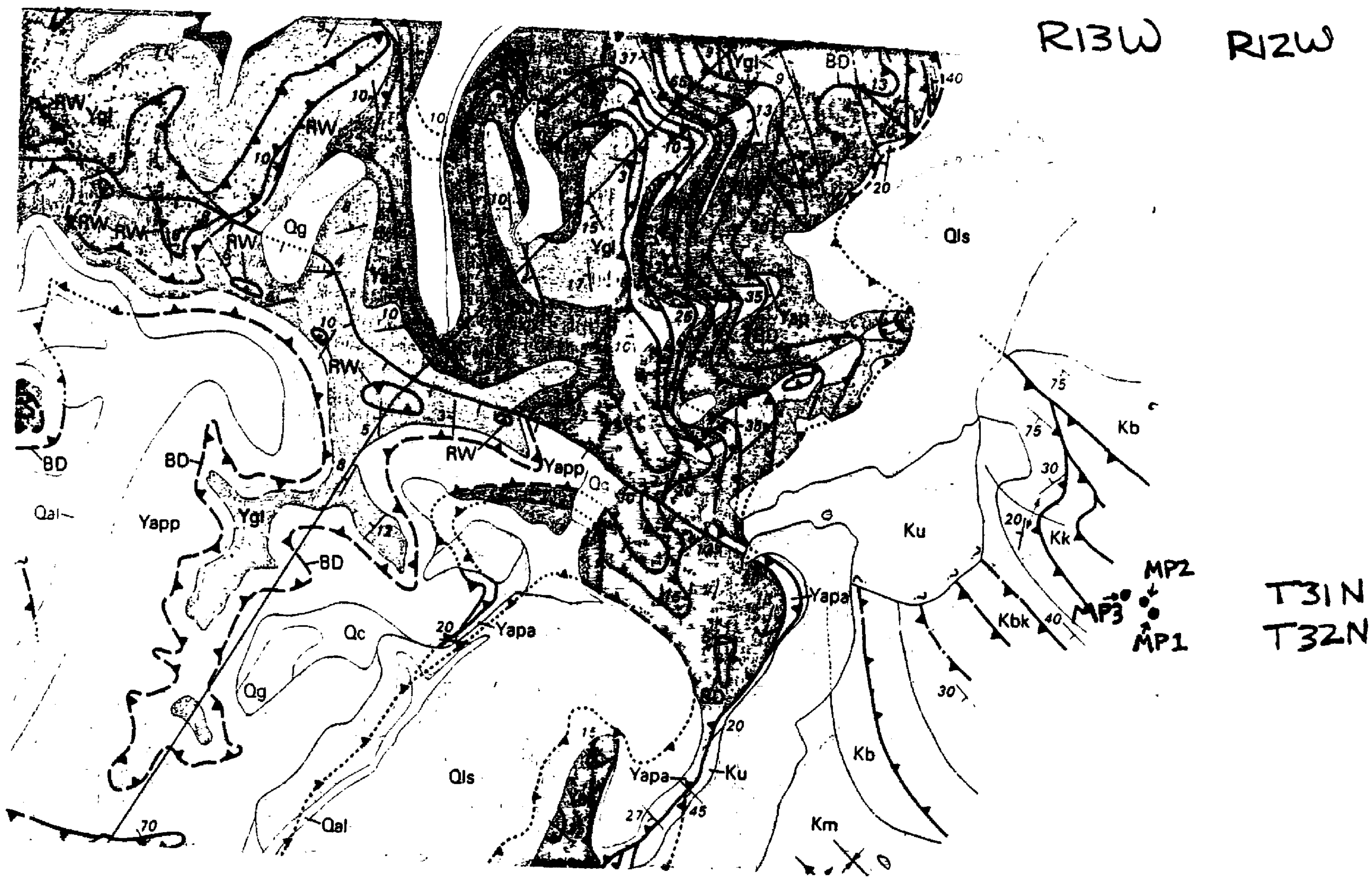


Figure 2b. Geologic map of the Marias Pass locality.

(Whipple, 1992)

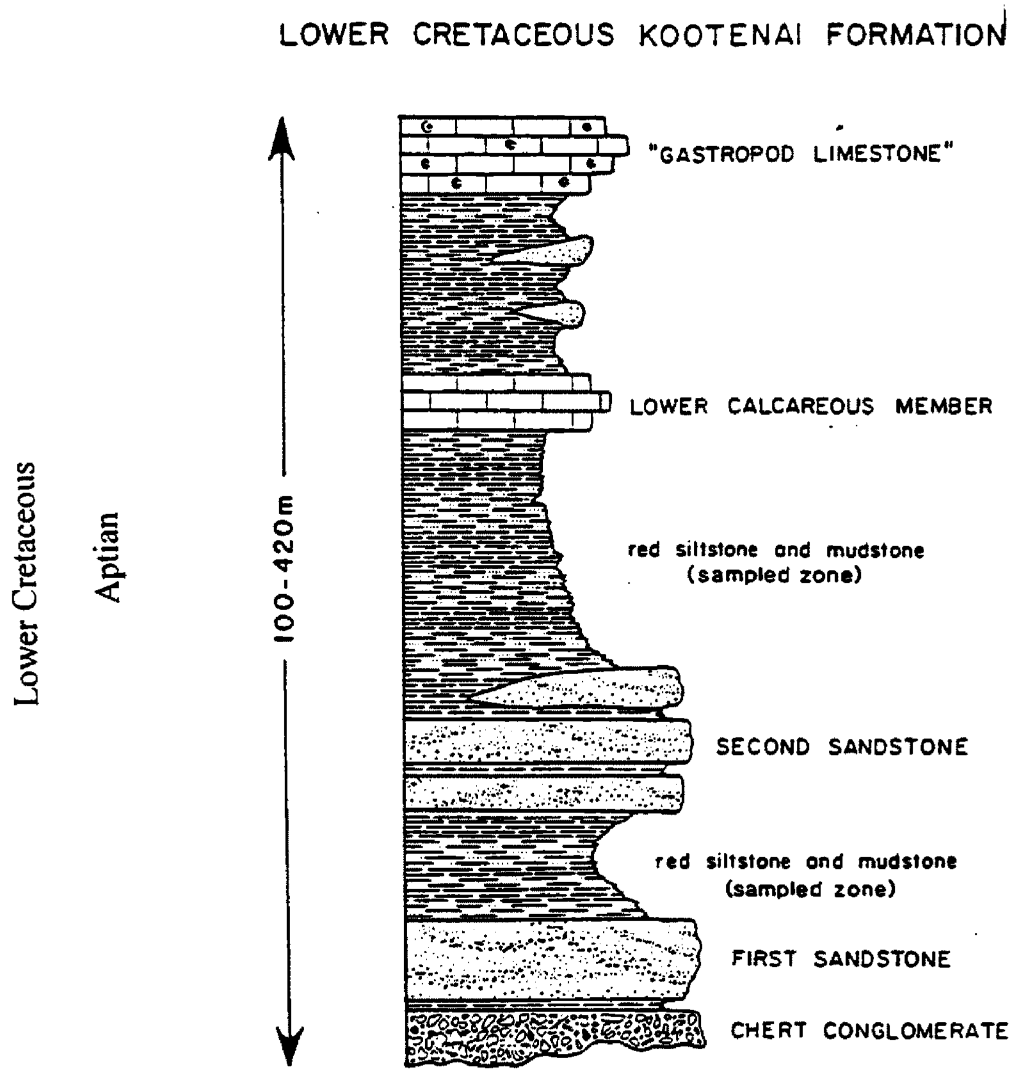


Figure 3. Stratigraphy of the Lower Cretaceous Kootenai Formation in western Montana (after DeCelles, 1986 and Eldredge and Van der Voo, 1988).

Field Methods

I chose two localities at which to sample the Kootenai Formation, in order to test the regional model of rotation, in the Montana Fold and Thrust Belt. The equigranular, well-sorted, nonmarine, oxidized sandstones of the lower siliceous member of the Kootenai outcrop with good exposure in both localities. The Ford Creek locality (Figure 2a) was chosen from the extensive mapping of Mudge *et al.* (1982) and Dolberg (1986) because of its exposure, a fairly tight fold, and close proximity to the road and water. The second locality, near Marias Pass on the southern tip of Glacier National Park (Figure 2b), was chosen because of the relatively undisturbed nature (Whipple, 1992) of the Middle Proterozoic through Cretaceous section.

At the Ford Creek locality I used standard paleomagnetic techniques (Butler, 1992) in collecting seven to ten cores from each of eight sites. In the northern, Marias Pass, locality I collected six to eight cores from each of three sites. At each of these sites the samples were distributed in less than 2.5 m of stratigraphic section. Ideally three samples were collected at the same stratigraphic level to test the paleomagnetic consistency of what is presumed to be contemporaneous material. In actuality, due to fracturing within the outcrop and availability, only 28 of the 80 samples were averaged into 16 specimens because they were believed to be penecontemporaneous. These samples were averaged, giving unit weight to the resultant specimens. The minimum stratigraphic separation of sites at a locality was approximately a half a meter while the maximum was approximately 18 m.

Coring was accomplished using a chainsaw, altered by Pomeroy Industries Unlimited, to spin a 2.5 cm diameter diamond bit. Samples were oriented in the field using a magnetic compass and, when possible, a sun compass. I was unable to obtain suncompass orientation for 25 of the 80 samples. However, for those samples with both orientations, the average angular difference between the two measurements was close to zero indicating that the samples were not altered by lightning strikes, the magnetic intensities of the samples were not high enough to affect the accuracy of the magnetic compass, and that there are not any localized anomalies associated with the magnetic field. Thus the samples lacking suncompass orientations are as reliably oriented as those with suncompass orientations.

Laboratory Techniques

Once back in the lab I cut the 80 samples collected in the field into 91, 2.5 cm specimens. Then I began preliminary, pilot demagnetization experimentation on representative specimens from the Ford Creek locality. These preliminary specimens were demagnetized using both alternating field (AF) and thermal (Th) techniques and measured using a Schonstedt SSM-2A Spinner Magnetometer at the University of Montana. For five of the specimens, a progressive alternating field demagnetization sequence, using a Molspin two-axis tumbling demagnetizer with a maximum induction of 100 mT, did not remove more than 50% of the magnetization. Therefore I employed thermal demagnetization on the remaining 13 specimens, using a homemade oven and a cooling chamber with a maximum induction of less than 6 nT, to finish the cleaning steps. However, due to the low intensities of the red beds, the Schonstedt SSM-2A Spinner Magnetometer was not sensitive enough to accurately measure the magnetization of the specimens in a reasonable amount of time. To circumvent this problem, I made arrangements to complete lab work at the University of New Mexico in Dr. John Geissman's lab. His magnetically shielded laboratory included a 2-G Enterprises 706R three axis, superconducting, cryogenic magnetometer, with the capability of accurate direction measurement below 1.0×10^{-5} A/m. I readily and accurately measured magnetizations as low as 5.0×10^{-5} A/m in Geissman's lab.

At the University of New Mexico, alternating field and thermal demagnetization were applied to a pilot specimen from each site from both localities. Alternating field cleansing was accomplished using a 2-G Enterprises demagnetizer. Thermal demagnetization was accomplished in two thermally separate chambers of a Schonstedt TSD-1 furnace. Six previously untreated specimens from the Ford Creek locality were subjected to alternating field demagnetization and again an induction of up to 100 mT was unable to remove more than about 50% of the magnetization. However, three pilot specimens from the Marias Pass locality reacted well to this form of demagnetization. The Natural Remanent Magnetization (NRM) intensities of the three Marias Pass sites were on the order of 1.0×10^{-2} A/m. Each specimen from the Marias Pass locality underwent between 12 and 25 cleaning steps with an induction of 2 to 120 mT. I chose demagnetization steps which eliminated 5 to 10% of the NRM at each step. The brick red specimens from the Ford Creek locality, with NRM intensities between 1.0×10^{-3} and 1.0×10^{-4} A/m and an unwillingness to react well to the alternating field technique, required thermal demagnetization. Cleaning temperatures ranging from 100° C to 685° C were applied in 8 to 15 steps. The heating time, or cleaning, of the specimens was increased with each sequential step. Specimens were heated for one minute per every ten degrees.

Interpretation of the demagnetization data was simplified using orthogonal projections as discussed by Zijderveld (1967). Statistics were calculated according to the methods of Fisher (1953). As with most paleomagnetic studies, I applied some arbitrary rejection criteria to specimens and sites. At the site level, a maximum of 20° was chosen for the radius (α_{95}) of the 95% confidence cone. This eliminated sites FC1 and FC9 at the Ford Creek locality. At the sample level, specimens giving a direction of more than two standard deviations away from the site mean were eliminated. This removed a total of seven specimens from the remaining nine sites. After application of these arbitrary rejection criteria, nine sites, with a total of 71 specimens, remained within the data set. Twenty-eight specimens were averaged because they were either obtained from the same core, or believed to be penecontemporaneous. Forty-one specimens from the Ford Creek locality and 14 from the Marias Pass locality remained for a total of 55 specimens for statistical analysis.

Paleomagnetic Results

The Ford Creek specimens demagnetized via thermal techniques to less than 15% of their NRM while the Marias Pass specimens decayed, via alternating field techniques, to less than 10% of their NRM. At these levels the signal to noise ratio had become too high to recover additional accurate directional information. Figures 4a and 4b present representative demagnetizations of specimens from the Ford Creek and Marias Pass localities.

To determine the age of acquisition of magnetization, the specimens from sites 3 and 4 of the Ford Creek locality were subjected to a fold test (Figure 5) as discussed by Butler (1992). The in-situ directions have an α_{95} of 12.7° with a precision parameter, k, of 11.6. After structural correction, α_{95} decreases to 6.5° and the precision parameter increases to 41.7. The expected F distribution value for N=13 and $F_{24,24}$ is 2.0. The calculated k_a/k_b is 3.6. This is well above the expected F distribution and the two sites pass the statistical test. Thus the sites successfully passed the fold test and the magnetization predates deformation. By inference, and similar demagnetization behavior, the same is true for the remainder of the sites sampled at Ford Creek.

It is necessary to adequately average paleosecular variation in any structural application of paleomagnetic directions (Cox, 1970; McFadden *et al.*, 1988; Merrill and McFadden, 1988). I used Cretaceous aged sedimentary units and sampled the units with the intent of sampling a substantial amount of geologic time. Within a site, it is optimum to have low dispersion of directions; between sights, tight clustering is not expected if

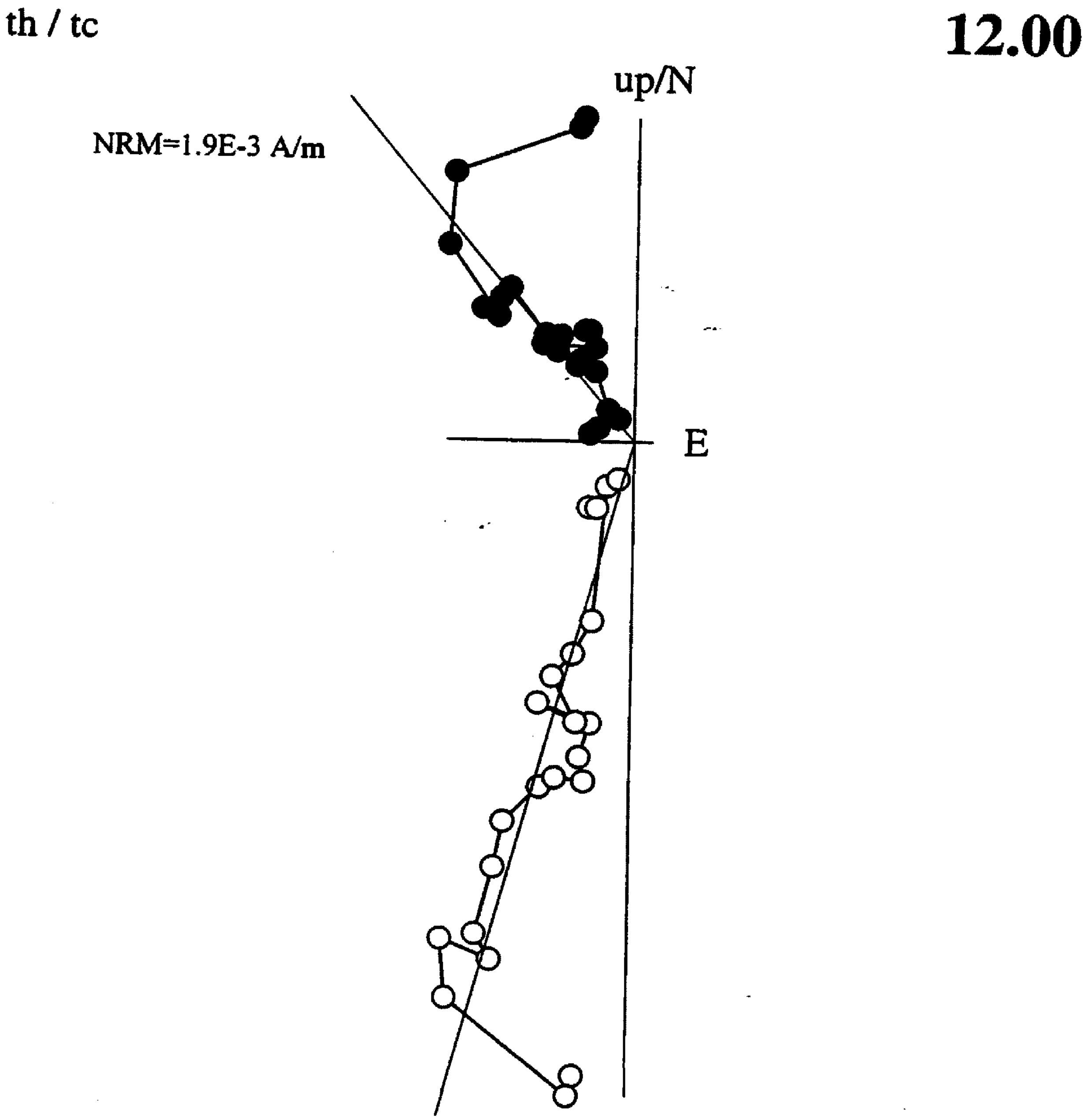


Figure 4a. Structurally corrected orthogonal projection (Zijderveld, 1967) of a representative specimen from the Ford Creek locality. Ford Creek demagnetization accomplished via thermal techniques.

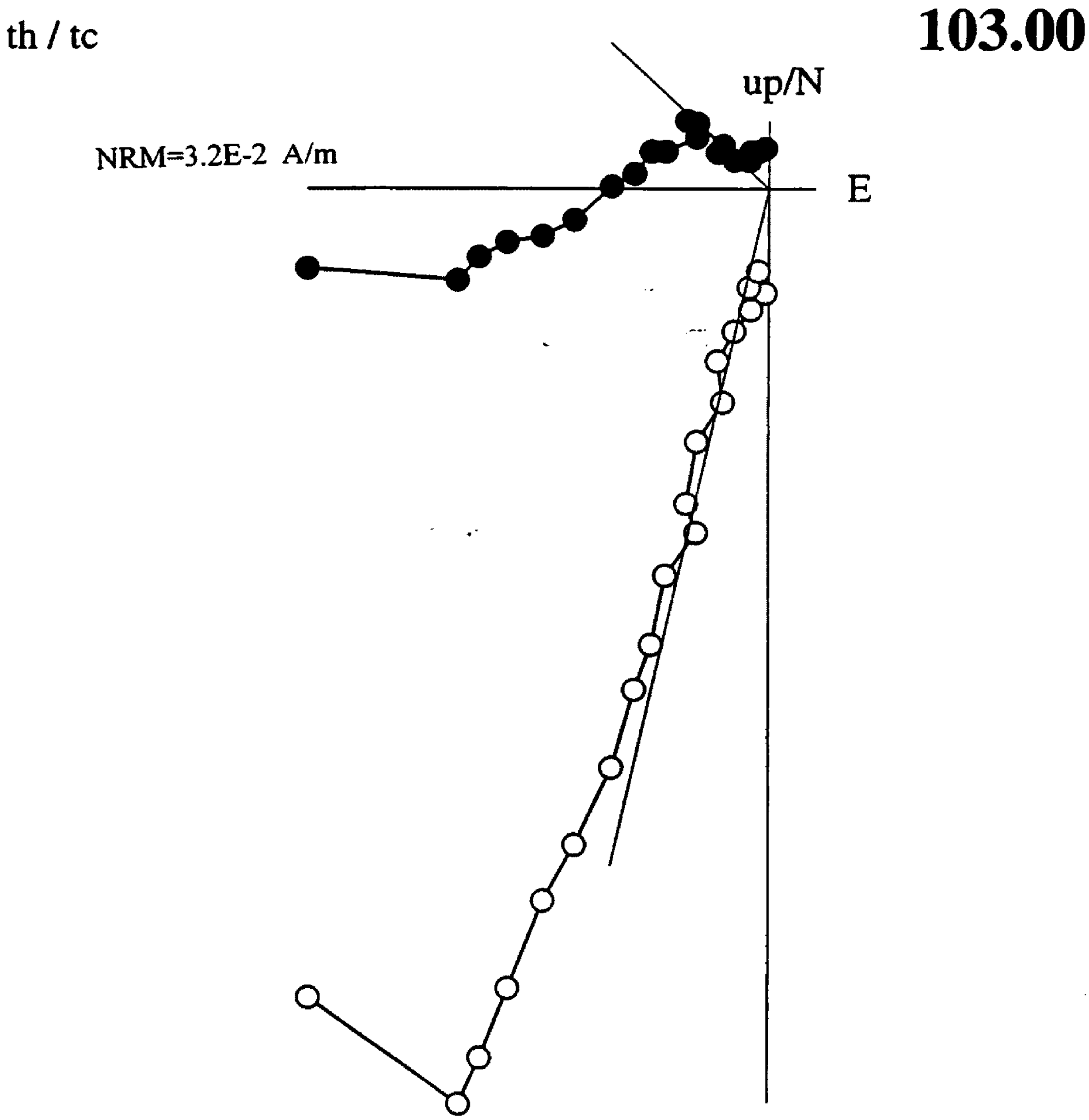


Figure 4b. Structurally corrected orthogonal projection (Zijderveld, 1967) of a representative specimen from the Marias Pass locality. Marias Pass demagnetization accomplished via alternating field techniques.

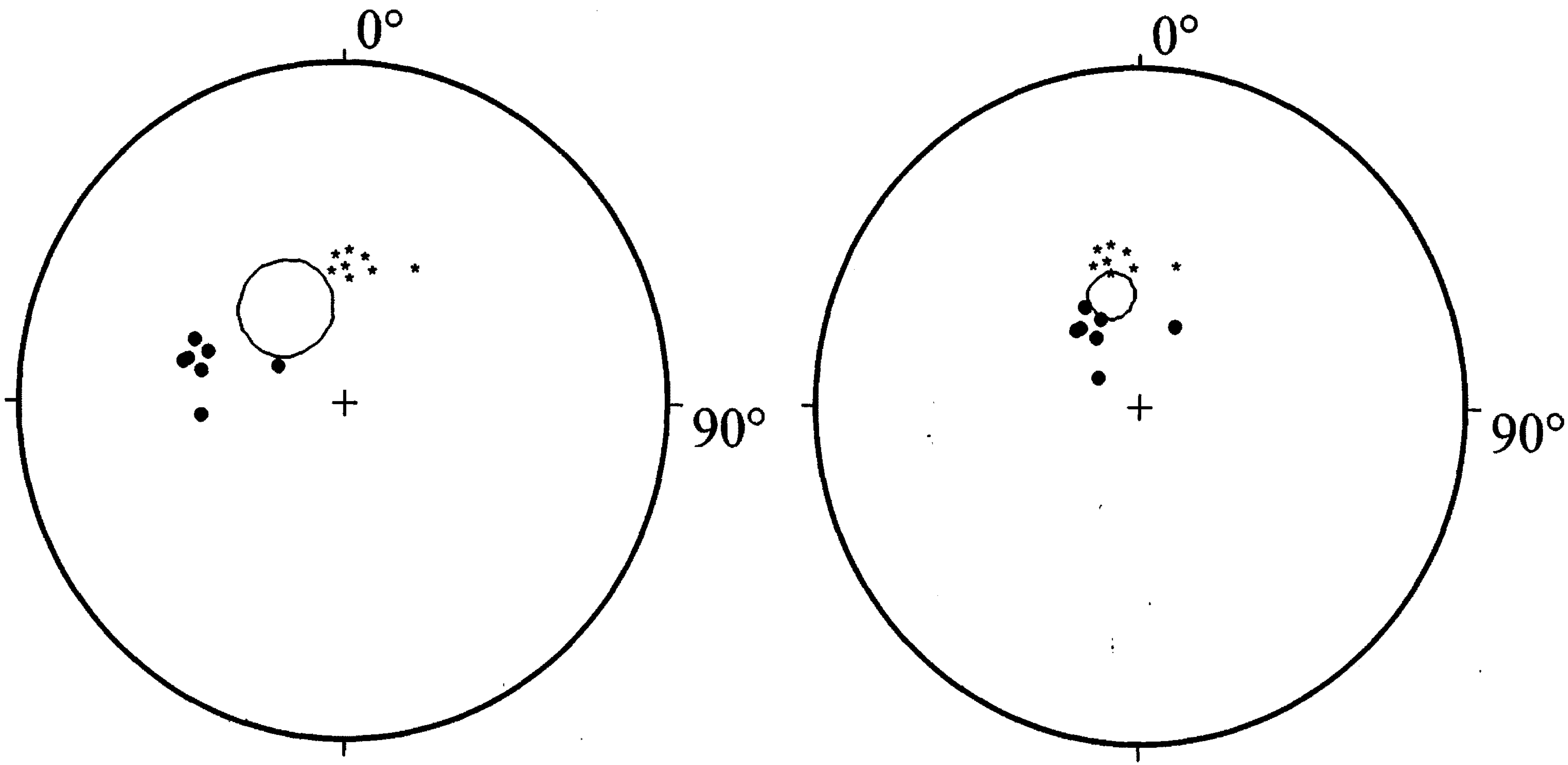


Figure 5. Equal area projection of in-situ (left, α95=12.7°, k=11.6) Ford Creek 3 directions (●) and Ford Creek 4 directions (*) with respect to their structurally corrected (right, α95=6.5°, k=41.7) directions.

sites are spread to sufficiently sample the longest period of paleosecular variation. The amount of expected dispersion varies as a function of paleolatitude (Cox, 1970; McFadden, *et al.*, 1988). Although McFadden *et al.* (1988) revise latitudinal estimates of Cox (1970), the values of Cox (1970) may be more appropriate for this study. This is in part due to the Cretaceous Normal (85-119 Ma), a geologically long amount of time during which the paleomagnetic field remained almost continuously in a normal state. McFadden *et al.* (1988) concentrate on the last 5 Ma while the rocks of this study are Lower Cretaceous. The expected δ_{63} for latitudes of 47° N and 48° N is approximately 17° (Cox, 1970). The δ_{63} values for the Ford Creek and Marias Pass localities are both within 5° of this value (Table 1). This increases one's confidence that the study has adequately averaged paleosecular variation.

One expects δ_{63} values to be low within a given site and increase when calculated between sites. My site-level δ_{63} values (Table 2) are below the expected δ_{63} for the paleofield (Cox, 1970). Yet they are somewhat higher than are typically found in a paleomagnetic study of volcanic rocks. Thus it is probable that paleosecular variation has been partially averaged at the site level. This further increases one's confidence that the study has adequately averaged paleosecular variation.

Another way to determine whether or not a study has adequately averaged paleosecular variation is to document the existence of polarity reversals within the sampled rocks. If reversals occur within a locality or between localities, then these samples must be separated in time by at least the maximum period of paleosecular variation. Unfortunately, there were no reversals recorded at the Ford Creek and Marias

Table 1. Structurally Corrected locality mean directions for the Ford Creek and Marias Pass localities.

Locality	Dec	Inc	VGP lat	VGP long	N/N_c	α_{95}	k	δ_{63}
Ford Creek	-9.2	62.5	78.3	32.1	6/8	3.7	37.2	13.3
Marias Pass	-39.5	60.2	45.6	245.4	3/3	11.3	13.3	21.6

Dec indicates locality mean declinations, clockwise is positive. Inc indicates locality mean inclinations. VGP lat, VGP long indicate latitude and longitudes of the VGP, reported north and east. N/N_c is the number of sites used in statistical analysis versus number sampled. α_{95}=semiangle of 95% confidence, k=Fisher (1953) precision parameter, δ_{63}=angular standard deviation.

Table 2. Structurally Corrected site mean directions for 9 sites.

site	latitude	longitude	dec	inc	N/Nc	VGP lat	VGP long	α_{95}	k	δ_{63}
FC3	47.381 N	247.318 E	-24.4	69.6	6/9	73.4	187.4	10.2	44.6	11.1
FC4	47.381 N	247.318 E	-7.1	55.1	7/12	77.1	93.9	5.2	136.7	6.4
FC5	47.381 N	247.318 E	0.1	55.9	8/15	79.0	66.9	8.9	39.4	12.1
FC6	47.381 N	247.318 E	6.0	70.0	7/9	82.4	275.2	5.1	141.7	6.3
FC7	47.381 N	247.318 E	-6.7	64.3	8/8	85.2	143.8	8.9	39.9	12.0
FC8	47.381 N	247.318 E	-23.0	60.4	5/7	72.6	145.7	16.1	23.5	15.0
MP1	48.411 N	246.767 E	-77.2	67.0	5/6	41.7	189.1	12.5	38.4	11.7
MP2	48.411 N	246.767 E	-78.9	66.7	4/6	40.5	189.3	8.9	107.4	6.8
MP3	48.411 N	246.767 E	37.7	46.9	5/5	54.7	357.9	16.0	23.9	14.9

FC sites are from the Ford Creek locality. MP represents Marias Pass sites. Dec indicates site mean declinations, clockwise is positive. Inc indicates site mean inclinations. N/N_c is the number of specimens used in statistical analysis versus number sampled. VGP lat, VGP long indicate VGP latitude and VGP longitudes, reported north and east. α_{95}=semiangle of 95% confidence, k=Fisher (1953) precision parameter, δ_{63}=angular standard deviation.

Pass localities. Because of the age of the Kootenai (Aptian, 108-115 Ma), the lack of reversals is not surprising as it is within the Cretaceous Normal (Butler, 1992).

In using sedimentary units for a paleomagnetic rotational analysis, it is important to determine whether the magnetization is chemical or detrital in nature to best estimate its age. Suttner (1969) and DeCelles (1986) limit the deposition and age of the Kootenai to Aptian (108 to 115 Ma). Eldredge and Van der Voo (1984) point out that there is a short amount of time between the deposition in the Early Cretaceous of the Kootenai Formation and the thrusting events of the Late Cretaceous Laramide Orogeny in Montana. Montana thrusting has been limited by Hoffman *et al.* (1976) to be within 56-72 Ma. This leaves approximately 40 Ma and narrowly limits the age of magnetization. Given that the magnetization predates deformation, the question of deposition rates and whether magnetization is of chemical or detrital origin is not particularly important in this case.

Table 2 presents the site mean directions, derived from the Characteristic Remanent Magnetization (ChRM) of the specimens for the sites used in statistical analysis. As specified in the rejection criteria, Table 2 indicates that for each site that was not removed, the α_{95} values are low and well below the maximum 20°. Since α_{95} is a statistical confidence level, the results suggest that the virtual geomagnetic poles (Table 2) are reliable.

The mineralogy of specimens in paleomagnetic studies can be estimated using thermal demagnetization techniques and determination of the Curie temperature of the specimens. The typical Curie temperatures of magnetite and hematite are 580° and 680° C, respectively. In the Ford Creek locality, approximately 35% of the magnetization remains after 580° C, implying that the dominant carrier of the characteristic component of magnetization in these red rocks is hematite. This can be seen in Figure 6a which presents the ratio of magnetization intensity and original magnetization intensity (J/J_o) versus demagnetization temperature for a representative specimen from the Ford Creek locality. Similarly, Figure 6b displays this same plot for a representative specimen from the Marias Pass locality. Less than 10% of the magnetization remains after 580° C, implying that the dominant carrier of the characteristic component of magnetization in the Marias Pass locality is magnetite. The observation that the Marias Pass specimens have a high percentage of magnetite than the Ford Creek specimens explains why each locality had a different reaction to demagnetization techniques. Because of the high coercive force of hematite, far greater than that of magnetite, it does not react well to alternating field techniques. Therefore, Ford Creek specimens had to be demagnetized via thermal demagnetization techniques while the Marias Pass specimens were demagnetized using alternating field demagnetization techniques.

The three sites of the Marias Pass locality, all of which passed the rejection criteria at the specimen level (Table 3), have an average structurally corrected declination and inclination of 320.5°, 60.2° (α_{95}=11.3°, k=13.3). The declination of each of the three sites is not close to this locality value. This is because the site mean declination of Marias Pass site 3 (MP3) differs from that of the other two sites by 116°.

Two of the Marias Pass sites shows an obvious and easily determined secondary component of magnetization (Figure 4b). Marias Pass sites 1 and 2 (MP1 and MP2) have

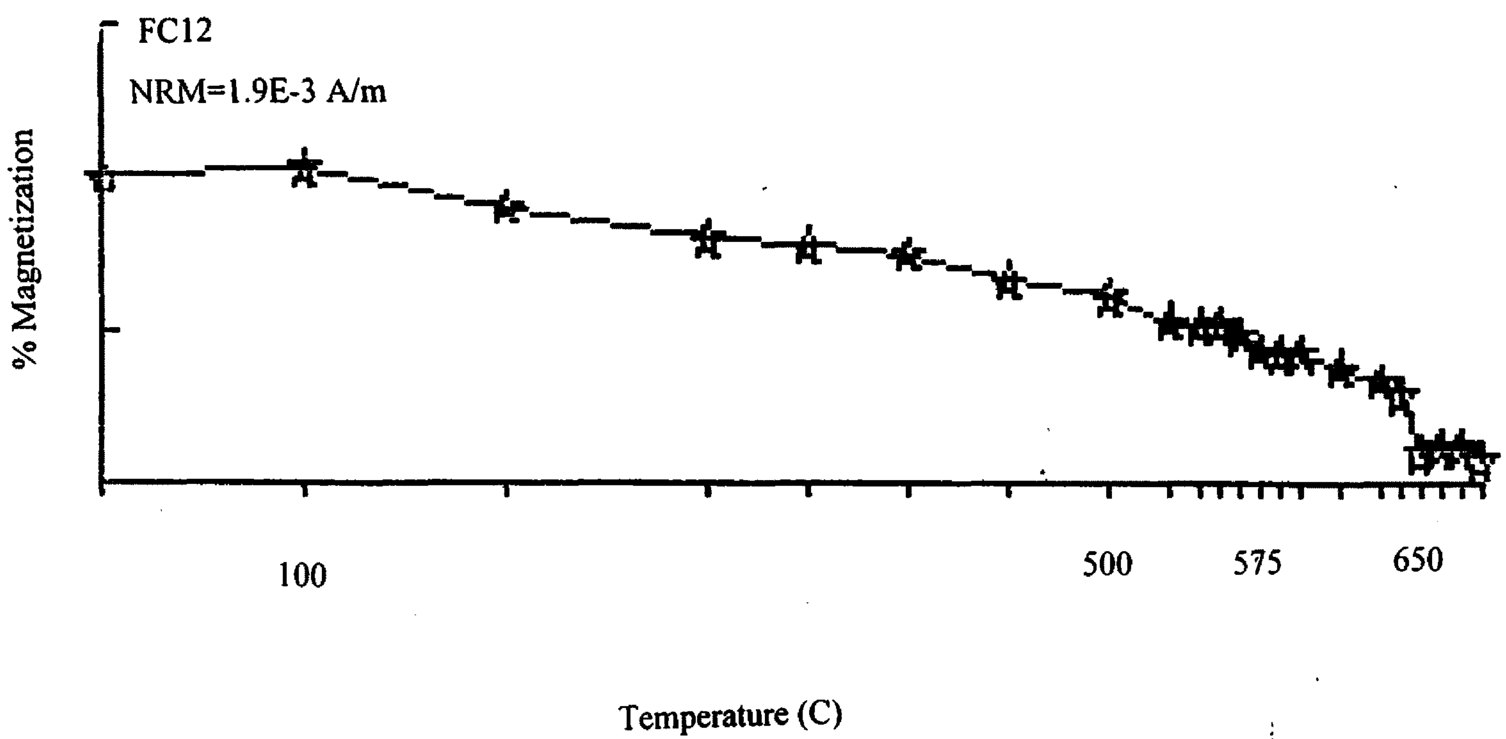


Figure 6a. Representative J/J_o plot for a sample from the Ford Creek locality.

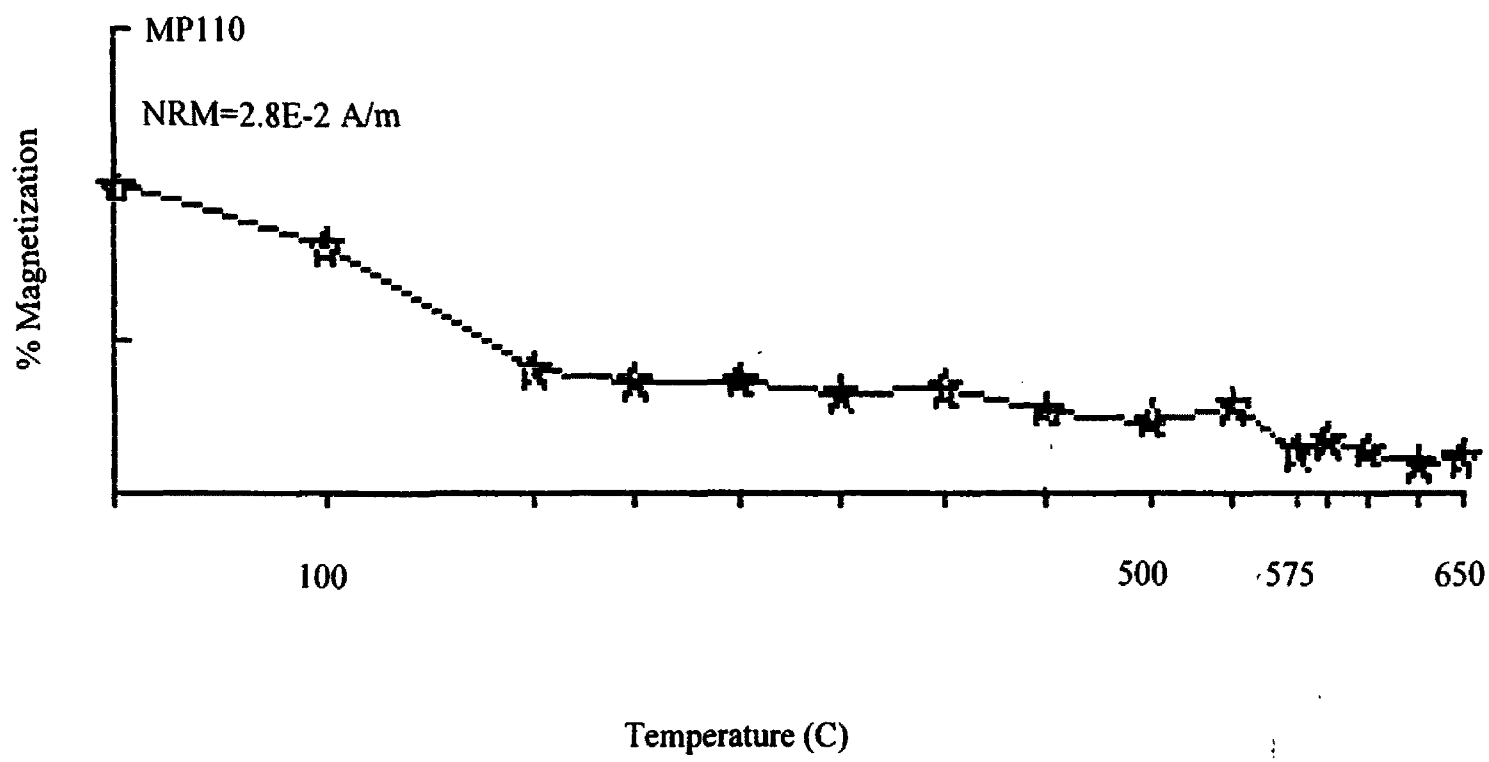


Figure 6b. Representative J/J_o plot for a sample from the Marias Pass locality.

Table 3. Structurally corrected primary and secondary directions for the Marias Pass locality.

site	dec	inc	N/N_c	α_{95}	k	δ_{63}
MP1	-77.2	67.0	5/6	12.5	38.4	11.7
MP2	-78.9	66.7	4/6	8.9	107.4	6.8
MP3	37.7	46.9	5/5	16.0	23.9	14.9
MP1s	52.7	54.1	5/6	7.9	94.8	7.4
MP2s	46.0	53.8	3/6	14.7	70.9	7.9

MP represents site mean directions from Marias Pass sites. MP1s and MP2s represent secondary directions from Marias Pass sites. Dec indicates site mean declinations, clockwise is positive. Inc indicates site mean inclinations. N/N_c is the number of specimens used in statistical analysis versus number sampled. α_{95}=semiangle of 95% confidence, k=Fisher (1953) precision parameter, δ_{63}=angular standard deviation.

prominent secondary directions (MP1s and MP2s) which can be separated from their characteristic components and were successfully removed in a 50 mT field. Although MP3 is statistically different from the directions of MP1 and MP2, it is statistically coincident with their secondary direction (Figure 7). Removing MP3 from the site mean statistics decreases the α_{95} from 11.3° to 6.7° and increases k from 13.3 to 60.5. At the same time, combining the direction of MP3 with the secondary components of MP1s and MP2s produces a mean declination and inclination of 45.5°, 51.6° (α_{95}=6.6°, k=40.9). Site 3 seems to have recorded the stable, overprinted, secondary direction that was isolated in analysis of the other two sites of this locality and is probably the result of Viscous Remanent Magnetization (VRM). Although MP3 did not fail the statistical criteria listed prior, based on its recording of an overprint direction, it will not be considered in further statistical analysis as it appears to be VRM from the present-day field.

Specimens from the Ford Creek locality show a very minor secondary component of magnetization (Figure 4a). Many of the NRM directions are close to that of the present-day magnetic field. Their orthogonal projections, with curved trajectories during progressive demagnetization between 0° and 250° C, straighten out at temperatures greater than 250° C and head toward the origin. Because this component has a relatively low unblocking temperature and its in-situ direction is parallel to the present-day field, it appears to be a VRM.

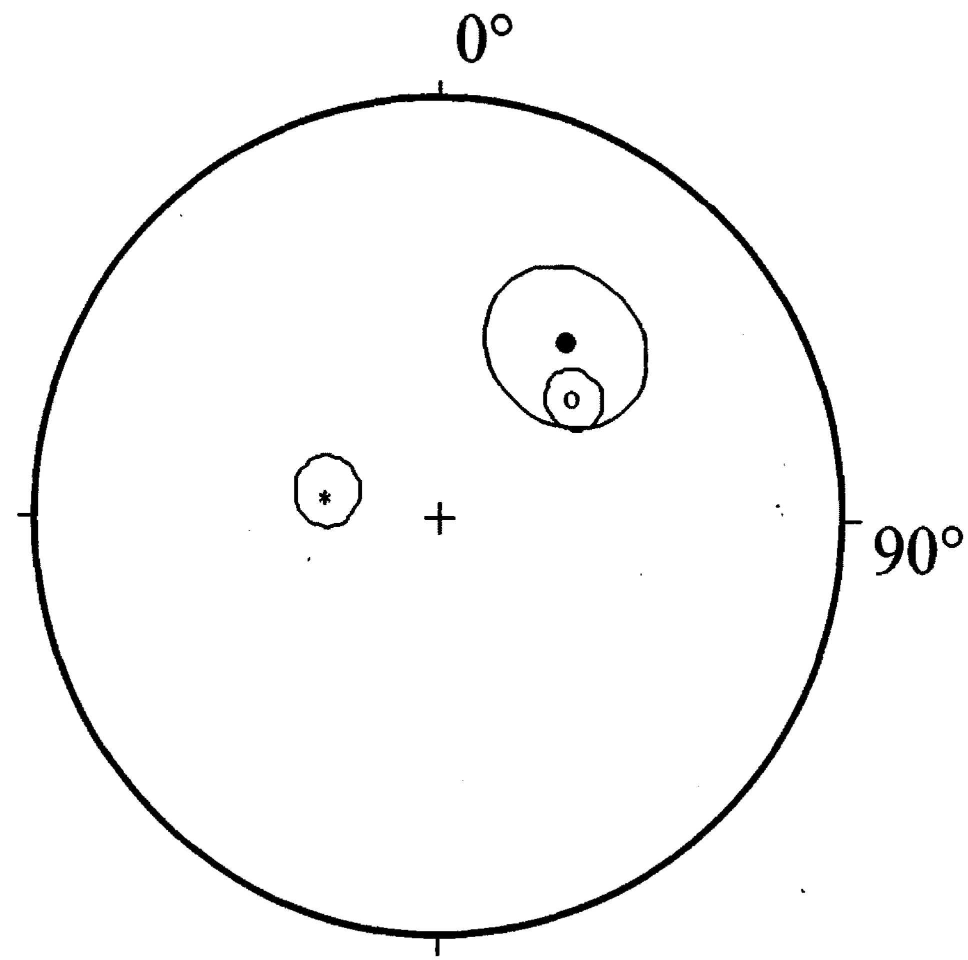


Figure 7. Equal area projection of the structurally corrected site-mean Marias Pass 3 direction (●, α95=16.0°, k=23.9) with respect to the site-mean Marias Pass 1 & 2 structurally corrected characteristic (*, α95=6.7°, k=60.5) and secondary (o, α95=5.8°, k=93.5) directions.

Discussion

Marias Pass Locality

When comparing the in-situ directions of the Marias Pass locality to the present-day field, it becomes apparent that this locality has been subjected to some remagnetization (Table 4). The expected declination and inclination for this locality with respect to the present-day field are 16.9°, 72.3° respectively. The in-situ secondary declination and inclination of the Marias Pass locality are 6.7°, 71.1° (α_{95}=8.9°, k=34.3) and are statistically coincident with the present-day field (Figure 8). Thus the secondary direction is most likely VRM from the present-day magnetic field. However the characteristic direction is not statistically coincident with the direction of the present-day magnetic field. Therefore it is presumed that the structurally corrected, characteristic direction for the Marias Pass locality (Dec=281.9°, Inc=66.9°) represents insight into the tectonic history of the terrain. Unfortunately, since MP3 was interpreted as a complete VRM overprint from the present-day field and was rejected, only two reliable sites remain from the Marias Pass locality. Two sites, even with some within-site averaging of paleosecular variation, are insufficient to yield a robust average. A fold test could not be performed in this locality to assess the timing of acquisition of magnetization because no folds were present and the structural trends of both sites were very similar.

Table 4. In-situ site mean primary and secondary directions of the Marias Pass locality and the present day field.

site	dec	inc	N/N_c	α_{95}	k	δ_{63}
MP1	5.8	49.3	5/6	17.6	19.8	16.4
MP2	2.3	51.8	4/6	8.8	109.6	6.7
MP1s	4.4	69.0	5/6	6.1	158.8	5.8
MP2s	9.0	73.2	3/6	13.4	86.4	7.1
Present day	16.9	72.3				

MP represents Marias Pass sites. MP sites with an 's' indicated secondary directions. Dec indicates site mean declinations, clockwise is positive. Inc indicates site mean inclinations. N/N_c is the number of specimens used in statistical analysis versus number sampled. α_{95}=semiangle of 95% confidence, k=Fisher (1953) precision parameter, δ_{63}=angular standard deviation.

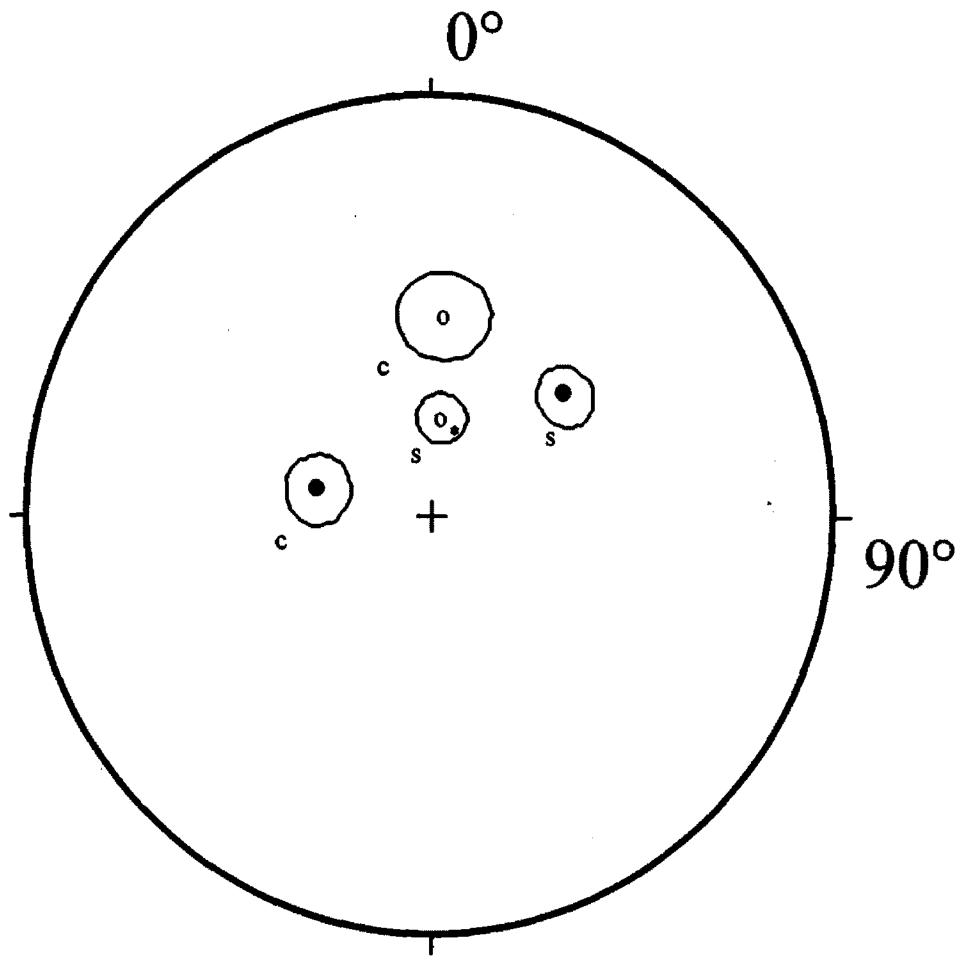


Figure 8. Equal area projection of the structurally corrected site-mean Marias Pass 1 & 2 directions (●) and the in-situ site-mean Marias Pass 1 & 2 directions (o) with respect to the present-day field (*). "c" represents characteristic directions (in-situ: $\alpha95=8.9°$, $k=34.3$; structurally corrected: $\alpha95=6.7°$, $k=60.5$). "s" represents secondary directions (in-situ: $\alpha95=4.9°$, $k=129.6$; structurally corrected $\alpha95=5.8°$, $k=93.5$).

Ford Creek Locality

For the six Ford Creek sites that passed the arbitrary rejection criteria, paleomagnetic site mean directions were determined using ChRM directions (Table 2). The in-situ site-mean declination and inclination for the Ford Creek locality are 345.9°, 53.0°. The calculated declination and inclination of the present-day magnetic field for the Ford Creek locality are 16.2°, 71.6°. The direction of the Ford Creek locality differs from that of the present-day field by 23° (α_{95}=6.6°, k=12.3). Thus the Ford Creek locality is statistically different from the present-day magnetic field. This locality also passed a fold test, substantiating that the magnetization predates deformation and is not a record of a more recent, or present-day, field.

Cretaceous Reference Poles

Many paleomagnetic studies have been interested in a more accurate and continuous assessment of the Cretaceous Apparent Polar Wander Path (Runcorn, 1956; Larochelle and Black, 1963; Larochelle *et al.*, 1965; Van Alstine and de Boer, 1978; Irving, 1979; Irving and Irving, 1982; Gordon *et al.*, 1984; Globerman and Irving, 1988; Van der Voo, 1990; Gunderson and Sheriff, 1991). The Lower Cretaceous Kootenai Formation, as discussed above, has been limited in age to be Aptian (108-115 Ma) by Suttner (1969) and DeCelles (1986) by means of flora and fauna. Thus reference poles from the Lower and Middle Cretaceous are relevant to the paleomagnetic results from the Ford Creek locality.

Larochelle and Black (1963) and Larochelle *et al.* (1965), following the work of Runcorn (1956), determined a reference paleopole for the 109±5 Ma Isachen diabasic rocks of the Northwest Territory, Canada. The pole is located at 69° N, 180° E (A_{95}=7.5°). Irving (1979) compiled the results of many studies to better determine the Apparent Polar Wander Path for the past 300 Ma. The path created contains a 110 Ma reference pole at 68° N, 185° E (A_{95}=5°). Later, Irving and Irving (1982) gathered paleomagnetic data for the same range of time in an attempt to better understand plate relations and Gondwana. To do so, they created Apparent Polar Wander Paths for North America, Northern Eurasia, Africa, South America, and Australia. The path for North America, which included the results of Larochelle and Black (1963), contains a 110 Ma reference pole at 69° N, 186° E (A_{95}=6°). The calculated Ford Creek declination and inclination, with respect to this paleopole, are 337.3°, 70.4°.

Gordon *et al.* (1984), following the work of Van Alstine and de Boer (1978), Irving (1979), Larochelle and Black (1963), and Larochelle *et al.* (1965) generated a synthetic continuous Cretaceous Apparent Polar Wander Path for North America. Their poles were calculated based on paleomagnetic Euler poles and rates of angular displacement of poles along their paths. Within the path created by Gordon *et al.* (1984) is a 110 Ma pole at 69.9° N, 189.6° E.

Globerman and Irving (1988) attempt to characterize the Middle Cretaceous paleomagnetic pole for North America by sampling Cretaceous-aged intrusive units in

Arkansas. Beck (1991) cites this pole (λ, ϕ 74.1° N, 192.5° E, A_{95}=5.7°) as the product of "extensive mapping, painstaking laboratory demagnetization, and exacting selection criteria." It differs from the first Cretaceous reference pole of Runcorn (1956) by less than 5° and includes Larochelle and Black (1963), Larochelle *et al.* (1965), Irving (1979), and Gordon *et al.* (1984). Because of its encompassing nature, Beck (1991) cites this pole as one of high confidence.

Eldredge and Van der Voo (1988) recognized the lack of a tight constraint on the age of the Kootenai Formation. Although they cite Van Alstine and de Boer (1978), to solve the age problem they measured and averaged two virtual geomagnetic poles from relatively undeformed Kootenai sites near Great Falls, Montana. When comparing the virtual geomagnetic poles from their sites within the salients to that of the average of the two sites from the stable craton, they obtained results which removed the question of the age of their unit and the expected position of their pole on the Apparent Polar Wander Path. The paleopole obtained from the two sites that they averaged on the stable craton is located at 78.4° N, 170.6° E (A_{95}=5.3°).

The Cretaceous reference field is fairly well defined. The Middle Cretaceous reference pole of Globerman and Irving (1988) is well determined and is within 5° of the first reference pole of Runcorn (1956). Therefore, one would expect latitudinal differences in other Cretaceous reference poles to be minimal. However, the Globerman and Irving (1988) pole has a latitude nearly 5° north of the other three poles. This is a substantial amount and probably due to the fact that this is a Middle Cretaceous pole (88-

100 Ma) as opposed to an Aptian (108-115 Ma) pole. Although accurate, the Globerman and Irving pole (1988) is most likely of the wrong age for this study.

The reference pole position of Eldredge and Van der Voo (1988) differs from the mean of the other four poles (Larochelle and Black, 1963; Larochelle *et al.*, 1965; Irving, 1979; Irving and Irving, 1982; and Gordon *et al.*, 1984) by 10°. Based on this inconsistency, the pole of Eldredge and Van der Voo (1988) is probably inappropriate for this study.

Of the four remaining, similar, reference poles the earliest documented reference pole (Larochelle and Black, 1963, Larochelle *et al.*, 1965) is within 3° of the most recently published pole (Gordon *et al.*, 1984). Irving and Irving (1982) cite the work of Larochelle and Black (1963) and Irving (1979) in their Apparent Polar Wander Path study of the past 300 Ma. The Irving and Irving (1982) study can be viewed as an updated reference pole and is cited often in rotational studies. Their path is also based on real data as opposed to being synthetically generated. Thus errors based on their poles are easily determined and readily understandable with respect to other paleomagnetic studies. For this reason, I use the Irving and Irving (1982) pole as the reference pole for the Ford Creek directions in order to test the rotational hypothesis for the Purcell Anticlinorium.

Rotation of the Ford Creek locality

Symons and Timmons (1992) measured a clockwise rotation of 37±12° within the Proterozoic units of the Purcell Anticlinorium. A recent model of Sears (1994) predicts a

25-30° clockwise rotation of the anticlinorium primarily based on structural restrictions. The Ford Creek and Marias Pass localities were paleomagnetically sampled and measured to further test observations and hypotheses concerning the rotation of the Purcell Anticlinorium. Given the remagnetization at the Marias Pass locality and only two reliable sites, only the mean direction from the Ford Creek locality is compared to the reference pole determined by Irving and Irving (1982).

Based on the Lower Cretaceous reference pole of Irving and Irving (1982), the expected declination and inclination of the Ford Creek locality are 328.1°, 69.7°. The structurally corrected declination and inclination for the Ford Creek locality are 350.8°, 62.5° (Table 1). The declination and inclination differences and associated confidence intervals, calculated based on the methods of Demarest (1983) and Butler (1992), between the Irving and Irving (1982) pole and the Ford Creek locality are 23±9° and 7±4°, respectively (Table 5) (Figure 9). This coincides with the clockwise rotation as measured by Symons and Timmons (1992) and provides a stronger basis for the hypothesis of Sears (1994). The apparent flattening of the observed inclination with respect to the expected inclination is statistically significant at the 95% confidence interval. Given my δ_{63} values are as expected, I suspect that the latitude discrepancy of these sedimentary rocks is due to a recording error known as inclination error (Butler, 1992). If true, this may explain why the reference pole of Eldredge and Van der Voo (1988) is also far sided with respect to Irving and Irving (1982).

The declination deviation is substantial and of similar magnitude as the rotational hypothesis of Sears (1994). It is also statistically coincident with the paleomagnetic

Table 5. Declination deviations between Ford Creek sites and a reference pole from Irving and Irving (1982).

site	dec	inc	dec dif	inc dif
FC3	-24.4	69.6	7+25	0+9
FC4	-7.1	55.1	25+9	-15+5
FC5	0.1	55.9	32+14	-14+8
FC6	6.0	70.0	38+13	0+5
FC7	-6.7	64.3	25+18	-5+8
FC8	-23.0	60.4	9+28	-9+13
		Ford Creek:	23+9	-7+4

FC represents Ford Creek sites. These are compared to the pole of Irving and Irving (1982) of latitude and longitude (69° N, 186° E (D/I 328.1°/69.7°). Dec dif indicates declination deviations, clockwise is positive. Inc dif indicates inclination deviations and are negative in the flattened direction.

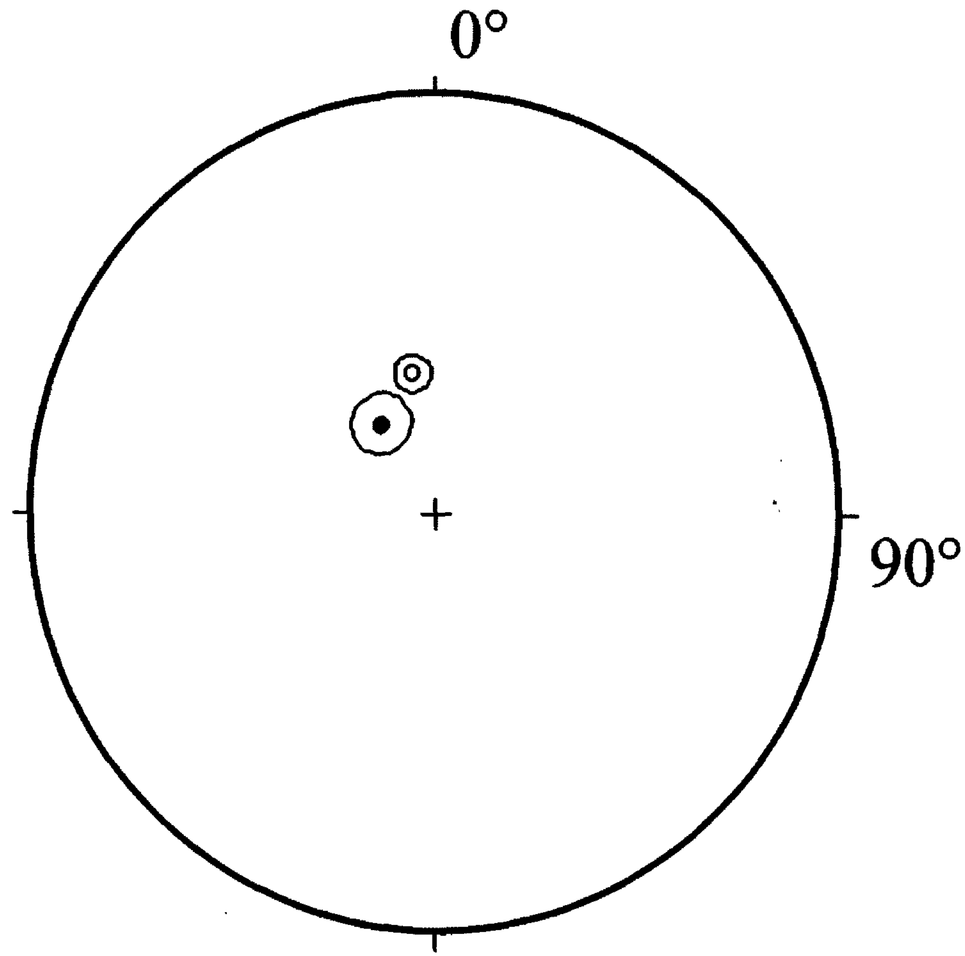


Figure 9. Equal area projection of the structurally corrected Ford Creek locality direction (o, α95=3.7°, k=37.3) with respect to the expected direction (●, α95=6°) based on Irving and Irving (1982).

evidence of Symons and Timmons (1992). Assuming the pole of Irving and Irving (1982) is representative of the Kootenai Formation, then the thrust sheet which houses the Ford Creek locality is likely to have undergone a rotation.

Paleomagnetic data from the Marias Pass locality are difficult to incorporate because one of three sites has been remagnetized. Yet the remaining two sites are likely to have some within-site averaging of paleosecular variation. Thus, based on the reference pole of Irving and Irving (1982), they suggest that this locality may have experienced a counterclockwise rotation of 45±16° and 4±6° of flattening. Symons and Timmons (1992) measured clockwise rotations of 37±12° and this study measured 23±9° of clockwise rotation in the Ford Creek locality. These two measurements are separated by approximately 300 km. The Marias Pass locality, while it is not a very robust indication of a counterclockwise rotation, is between these two measurements. Because the Ford Creek locality was the only reliable locality to compare with the reference pole of Irving and Irving (1982), it is difficult to determine the extent of the rotation. While the regional rotation model of Sears (1994) is one possible explanation for the results of this study, another explanation is that the thrust sheet has experienced a small scale vertical axis rotation based on impingement from the topography of the craton.

Conclusion

Six reliable sites from the Ford Creek locality indicate that the thrust sheet which houses this locality has rotated 23±9° clockwise based on the reference pole of Irving and Irving (1982) (Figure 9). With the partial remagnetization of the Marias Pass locality, statistics from this locality proved to be insufficient for a confident interpretation of the apparent counterclockwise rotation. With reliable paleomagnetic results from one locality to compare to a reference pole, it is difficult to discern whether or not this is a localized, vertical axis rotation (e.g. Grubbs and Van der Voo, 1976; Schwartz and Van der Voo, 1984; Eldredge and Van der Voo, 1988; Jolly and Sheriff, 1992) or whether this is indicative of a regional rotation of the Purcell Anticlinorium about an Euler pole (Symons and Timmons, 1992; Sears, 1994).

References

Beck, M.E., 1980, Paleomagnetic record of plate-margin tectonic processes along the western edge of North America: Journal of Geophysical Research, v. 85, no. B12, p. 7115-7131.

Beck, M.E., 1991, Case for northward transport of Baja and coastal southern California: Paleomagnetic data, analysis, and alternatives: Geology, v. 19, p. 506-509.

Butler, R.F., 1992, Paleomagnetism: Elsevier, New York, 319 pages.

Chamberlain, K.R., and Doughty, P.T., 1993, Middle Proterozoic mafic magmatism, east central Idaho: Implications for age of deposition of Belt Supergroup and basin subsidence models: Geological Society of America Abstracts with programs, v. 25, no. 5, p. 19.

Colpron, M. and Price, R.A., 1995, Tectonic significance of the Kootenay terrane, southeastern Canadian Cordillera: An alternative model: Geology, v. 23, no. 1, p. 25-28.

Cook, F.A., and Van der Velden, A. J., 1995, Three-dimentional crustal sructure of the Purcell Anticlinorium in the Cordillera of southwestern Canada: Geological Society of America Bulletin, v. 107, p. 642-664.

Cox, A., 1970, Latitude dependence of the angular dispersion of the geomagnetic field: Geophysical Journal of the Royal Astronomical Society, v. 20, p. 253-269.

DeCelles, P.G., 1986, Sedimentation in a tectonically partitioned, nonmarine foreland basin: The Lower Cretaceous Kootenai Formation, southwestern Montana: Geological Society of America Bulletin, v. 97, p. 911-931.

Demarest, H.H, 1983, Error analysis for the determination of tectonic rotation from paleomagnetic data: Journal of Geophysical Research, v. 85, no. B5, p. 4,321-4,328.

Dolberg, D.M., 1986, A duplex beneath a major overthrust plate in the Montana Disturbed Belt: Surface and subsurface data: University of Montana M.S. thesis, 57 p.

Eldredge, S., and Van der Voo, R., 1988, Paleomagnetic study of thrust sheet rotations in the Helena and Wyoming salients of the northern Rocky Mountains: in Schmidt, C.J., and Perry, W.J., eds., Interaction of the Rocky Mountain foreland and the Cordilleran thrust belt: Geological Society of America Memoir 171, Ch. 11, p. 319-332.

Elston, D.P., and Bressler, S.L., 1980, Paleomagnetic poles and polarity zonation from the Middle Proterozoic Belt Supergroup, Montana and Idaho: Journal of Geophysical Research, v. 85, no. B1, p. 339-355.

Fisher, R.A., 1953, Dispersion on a sphere: Royal Society of London Proceedings, v. 217, p. 295-332.

Globerman, B.R., and Irving, E., 1988, Mid-Cretaceous paleomagnetic reference field for North America: Restudy of 100 m.a. intrusive rocks from Arkansas: Journal of Geophysical Research, v. 93, no. B10, p. 11,721-11,733.

Gordon, R.G., Cox, A., and O'Hare, S., 1984, Paleomagnetic euler poles and the Apparent Polar Wander and absolute motion of North America since the Carboniferous: Tectonics, v. 3, no. 5, p. 499-537.

Grubbs, K.L., and Van der Voo, R., 1976, Structural deformation of the Idaho-Wyoming overthrust belt (U.S.A.), as determined by Triassic paleomagnetism: Tectonophysics, v. 33, p. 321-336.

Gunderson, J.A., and Sheriff, S.D., 1991, A new Late Cretaceous paleomagnetic pole from the Adel Mountains, west central Montana: Journal of Geophysical Research, v. 96, no. B1, p. 317-326.

Hoffman, J., Hower, J., and Aronson, J.L., 1976, Radiometric dating of time of thrusting in the disturbed belt of Montana: Geology, v. 4, p. 16-20.

Höy, T., 1989, The age, chemistry, and tectonic setting of the Middle Proterozoic Moyie sills, Purcell Supergroup, southeastern British Columbia: Canadian Journal of Earth Science, v. 26, p. 2,305-2,317.

Irving, E., 1979, Paleopoles and paleolatitudes of North America and speculations about displaced terrains: Canadian Journal of Earth Sciences, v. 16, n. 3, p. 669-694.

Irving, E., and Archibald, D.A., 1990, Bathozonal tilt corrections to paleomagnetic data from Mid-Cretaceous plutonic rocks: Examples from the Omineca Belt, British Columbia: Journal of Geophysical Research, v. 95, no. B4, p. 4579-4585.

Irving, E., and Irving, G.A., 1982, Apparent Polar Wander Paths Carboniferous through Cenozoic and the assembly of Gondwana: Geophysical Survey, v. 5, p. 141-188.

Irving, E., and Wynne, P.J., 1991, Paleomagnetism: review and tectonic implications, Ch. 3 in Gabrielse, H., and Yorath, C.J., eds., Geology of the Cordilleran Orogen in Canada, Geology of Canada, no.4, p. 61-68.

Irving, E., Wynne, P.J., Evans, M.E., and Gough, W., 1986, Anomalous paleomagnetism of the Crowsnest Formation of the Rocky Mountains: Canadian Journal of Earth Sciences, v. 23, p. 591-598.

Irving, E., Wynne, P.J., Thorkelson, D.J., and Schiaizza, P., 1996, Large (1,000 to 4,000 km) northward movements of tectonic domains in the northern Cordillera, 83 to 45 m.a.: Journal of Geophysical Research, v. 101, no. B8, p. 17,901-17,916.

Jolly, A.D., and Sheriff, S.D., 1992, Paleomagnetic study of thrust-sheet motion along the Rocky Mountain front in Montana: Geological Society of America Bulletin, v. 104, p. 779-785.

Larochelle, A, and Black, R.F., 1963, An application of paleomagnetism in estimating the age of rocks: Nature, v. 198, no. 4887, p. 1260.

Larochelle, A, Black, R.F., and Wanless, R. K., 1965, Paleomagnetism of the Isachsen Diabasic rocks: Nature, v. 208, no. 5006, p. 179.

Link, P.K., Christie-Blick, N., Devlin, W.J., Elston, D.P., Horodyski, R.J., Levy, M., Miller, J.M.G., Pearson, R.C., Prave, A., Stewart, J.H., Winston, D., Wright, L.A., and Wrucke, C.T., 1993, Middle and Late Proterozoic stratified rocks of the western US Cordillera, Colorado Plateau, and Basin and Range province, in Reed, J.C., Jr., Bickford, M.E., Houston, R.S., Link, P.K., Rankin, D.W., Sims, P.K., and Van Schmus, W.R., eds., Precambrian: Conterminous U.S.: Boulder, Colorado, Geological Society of America, The Geology of North America, v. C-2, Ch. 6, p. 463-490.

McFadden, P.L., and Lowes, F.J., 1981, The descrimination of mean directions drawn from Fisher distributions: Geophysical Journal of Research, Royal Astronomical Society, v. 67, p. 19-33.

McFadden, P.L., Merrill, R.T., and McElhinny, M.W., 1988, Dipoloe/quadrupole family modeling of paleosecular variation: Journal of Geophysical Research, v. 93, no. B10, p. 11,583-11,588.

Merrill, R.T., and McFadden, P.L., 1988, Secular variation and the origin of geomagnetic field reversals: Journal of Geophysical Research, v. 93, no. B10, p. 11.589-11,597.

Monger, J.W.H., and Price, R.A., 1979, Geodynamic evolution of the Canadian Cordillera-progress and problems: Canadian Journal of Earth Sciences, v. 16, p. 770-791.

Mudge, M.R., Earhart, R.L., Whipple, J.W., and Harrison, J.E., 1982, Geologic structure maps of the Choteau 1X2 degree quadrangle, western Montana: U.S. Geological Survey, Map I-1300, scale 1:250,000.

Price, R.A., and Carmichael, D.M., 1986, Geometric test for Late Cretaceous-Paleogene intracontinental transform faulting in the Canadian Cordillera: Geology, v. 14, p. 468-471.

Ross, G.M., Parrish, R.R., and Dudás, F.Ö., 1991, Provenance of the Bonner Formation (Belt Supergroup), Montana: Insights from U-Pb and Sm-Nd analyses of detrital minerals: Geology, v. 19, p. 340-343.

Ross, G.M., Parrish, R.R., and Winston, D., 1992, Provenance and U-Pb geochronology of the Mesoproterozoic Belt Supergroup (northwestern United States): Implications for age of deposition and pre-Panthalassa plate reconstruction: Earth and Planetary Science Letters, v. 113, p. 57-76.

Runcorn, S., 1956, Paleomagnetic survey in Arizona and Utah: Preliminary results: Geological Society of America Bulletin, v. 67, p. 301-316.

Schwartz, S.Y., and Van der Voo, R., 1984, Paleomagnetic study of thrust sheet rotation during foreland impingemnet in the Wyoming-Idaho overthrust belt: Journal of Geophysical Research, v. 89, no. B12, p. 10,077-10,086.

Sears, J.W., 1994, Thrust rotation of the Belt Basin, Canada, and United States: Northwest Geology, v. 23, p. 81-91.

Smith, J.G., 1965, Fundamental transcurrent faulting in northern Rocky Mountains: American Association of Petroleum Geologists Bulletin, v. 49, no. 9, p. 1398-1409.

Suttner, L.J., 1969, Stratigraphic and petrologic analysis of Upper Jurrasic-Lower Cretaceous Morrison and Kootenai formations, southwest Montana: American Association of Petroleum Geologists Bulletin, v. 53, no. 7, p. 1391-1410.

Symons, D.T.A., and Timmons, E.A., 1992, Geotectonics of the cratonic margin from paleomagnetism of the Middle Proterozoic Aldridge (Prichard) Formation and Moyie sills of British Columbia and Montana: in Bartholomew, M.J., Hyndman, D.W., Mogk, D.W., and Mason, R., eds., Basement tectonics 8: Characterization and comprehension of ancient Mesozoic continental margins- Proceedings of the 8th international conference on basement tectonics (Butte, Montana, 1988) p. 373-384.

Van Alstine, D.R., and de Boer, J., 1978, A new technique for constructing apparent polar wander paths and the revised Phanerozoic path of North America: Geology, v. 6, p. 137-139.

Van der Velden, A.J., and Cook, F.A., 1996, Structure and tectonic development of the southern Rocky Mountain trench: Tectonics, v. 15, no. 3, p. 517-544.

Van der Voo, R., 1990, Phanerozoic paleomagnetic poles from Europe and North America and comparisons with continental reconstructions; Reviews in Geophysics, v. 28, n. 2, p. 167-206.

Whipple, J.W., 1992, Geologic map of Glacier National Park: U.S. Geological Survey, Map I 1508, scale 1:100,000.

Woodward, L.A., 1981, Tectonic framework of Disturbed Belt of west-central Montana: American Association of Petroleum Geologists Bulletin, v. 65, no. 2, p. 291-302.

Wynne, P.J., Irving, E., Schulze, D.J., Hall, D.C., and Helmstaedt, H.H., 1992, Paleomagnetism and age of three Canadian Rocky Mountain diatremes: Canadian Journal of Earth Sciences, v. 29, p. 35-47.

Zijderveld, J.D.A., 1967, A.C. demagnetization of rocks: Analysis of results, in Methods in paleomagnetism, edited by D.W. collinson, K.M. Creer, and S.K. Runcorn, Elsevier, New York p. 254-286.

Appendix A

The Kootenai Formation

The Lower Cretaceous Kootenai Formation (Figure 3) was chosen for paleomagnetic sampling. It was selected based on the mapping and stratigraphy of Dolberg (1986) and Mudge *et al.* (1982) and because the unit yielded good paleomagnetic results in the study of Eldredge and Van der Voo (1989). Good results implies four things: the Kootenai contains a measurable amount of magnetization, it reacted well to laboratory demagnetization, the magnetization predated deformation, and the unit adequately averaged paleosecular variation.

The Kootenai is a predominantly siliceous unit of sandstones, siltstones, and mudstones. Its basal member is a chert conglomerate and the formation is capped by a calcareous marker bed containing numerous gastropods. This biomicritic member, deposited in a fresh water lake, is called the "Gastropod Limestone." Another calcareous member within the Kootenai Formation splits the sandstones, siltstones, and mudstones into upper and lower members. The beds of the siliceous members generally alternate between red and green in the upper siliceous unit and red and brown in the lower siliceous unit. The equigranular, well-sorted, nonmarine oxidized sandstones of the lower siliceous member of the Kootenai Formation were sampled. (Suttner, 1969; DeCelles, 1986)

When units alternate between red and green layers, this usually implies that both the oxidized and reduced form of iron are present. Hematite ($[Fe^{3+}]_2[O^{2-}]_3$) is more oxidized than its reduced counterpart, magnetite ($[Fe^{2+}]\ [Fe^{3+}]_2[O^{2-}]_2$). Since very red layers were sampled in the Ford Creek locality, a high hematitic content was expected. In the Marias Pass locality, the beds sampled were not as brick red as the beds in the Ford Creek locality.

Suttner (1969) dates the Kootenai Formation based on gastropods and pelecypods. The pelecypods abundant in most of the Kootenai are Aptian in age (108-115 Ma). Also, units of the Blairmore Group, of Alberta Canada, have been correlated with the Upper Kootenai. The top of the Blairmore Group has been dated through flora as Albian in age (97-108 Ma). DeCelles (1986) also dates the Kootenai as Aptian and brackets it by dating the underlying Morrison Formation and the overlying Blackleaf Formation. The Kootenai Formation rests unconformably on the Morrison Formation, which has been dated by fossils as Kimmeridgian age (143-146 Ma). The overlying, conformable, Blackleaf Formation has been dated as Albian age (97-108 Ma).

Appendix B

Future Studies

Based on the paleomagnetic data of this study, the hypothesis of Sears (1994) and model of Symons and Timmons (1992) could not be supported or refuted. One site from the Marias Pass locality was rejected based on an overprint form the present-day field. This left only two sites in the Marias Pass locality for statistics and analysis. The Ford Creek locality recorded a 23±9° clockwise rotation from the expected Early Cretaceous reference pole of Irving and Irving (1982). However, this measurement is not conclusive of a rotation of the Purcell Anticlinorium as a cohesive unit. Instead it may be associated with a small, localized, vertical axis rotation. To determine the extent of the rotation, either more data is needed from the Marias Pass locality, or paleomagnetic data from a new locality is needed.

The Cretaceous units of Marias Pass locality offered few outcrops without extensive fracturing. For these reasons, if Cretaceous units are to be sampled, Marias Pass may not an ideal choice in a locality. Another possibility is to choose non-Cretaceous units. In this case, it would be optimum to sample two new localities rather than try to correlate the results to those from Ford Creek. This may eliminate error.

Great care should be taken in choice of new localities. In light of the result of this study and of previous studies, the craton seems to have considerable effects on the thrust sheet at its margin. For this reason, localities should be chosen where the thrust sheet is substantially thicker and acting as a cohesive unit.

Appendix C

Data

Below is a compilation of Zijderveld (1967) diagrams for all of the specimens from the six non-rejected Ford Creek sites and all three Marias Pass sites. Each site has a cover page followed by the structurally corrected Zijderveld (1967) diagrams, for each specimen, with a best fit characteristic remanent magnetization direction.

A general explanation of the diagrams is as follows:

- Each diagram can be divided into two sections: data and figure.
- The data section is comprised of eight columns.
- Column 1 is the demagnetization step. Numbers in this column that are on the order of 10 imply AF demagnetization; Numbers in this column on the order of 100 imply Th demagnetization.
- Columns 2, 3, and 4 are the x, y, z vector component intensities of the specimen. The units for these values are 10E-6 A/m.
- Columns 5 and 6 are the directional components of declination and inclination, respectively.
- Column 7 is the total intensity of the specimen. The units for these values are 10E-6 A/m.
- Column 8 is the measurement error.

• Between the data and the figure is the information gained from the trend of the best fit line, including declination and inclination.

• The figures are typical Zijderveld (1967) diagrams. The convention of this study is to plot declination (•) information with north on the vertical axis. This plots inclination (o) information on the up and east axes.

• The upper left corner of the figure contains a "th" for thermal demagnetization (which is inaccurate for a few of the Ford Creek specimens and nearly all of the Marias Pass specimens) and a "tc" for "tilt" corrected (this is accurate).

• The upper right corner contains the specimen number and, when appropriate, a "B" for the second specimen from that sample. If an "F" appears after the specimen, it means that the specimen was subjected to AF demagnetization. The "F" convention was only used in the Ford Creek locality as Th demagnetization was the norm.

Ford Creek 3

Specimens:

11, 12, 13, 14 & 18 (avg), 16, 17 & 17F (AF demag)

In-situ:

Dec=-74.31°, Inc=55.17°

α_{95}=10.11°

k=44.88

δ_{63}=11.06°

Structurally corrected:

Dec=-24.44°, Inc=69.57°

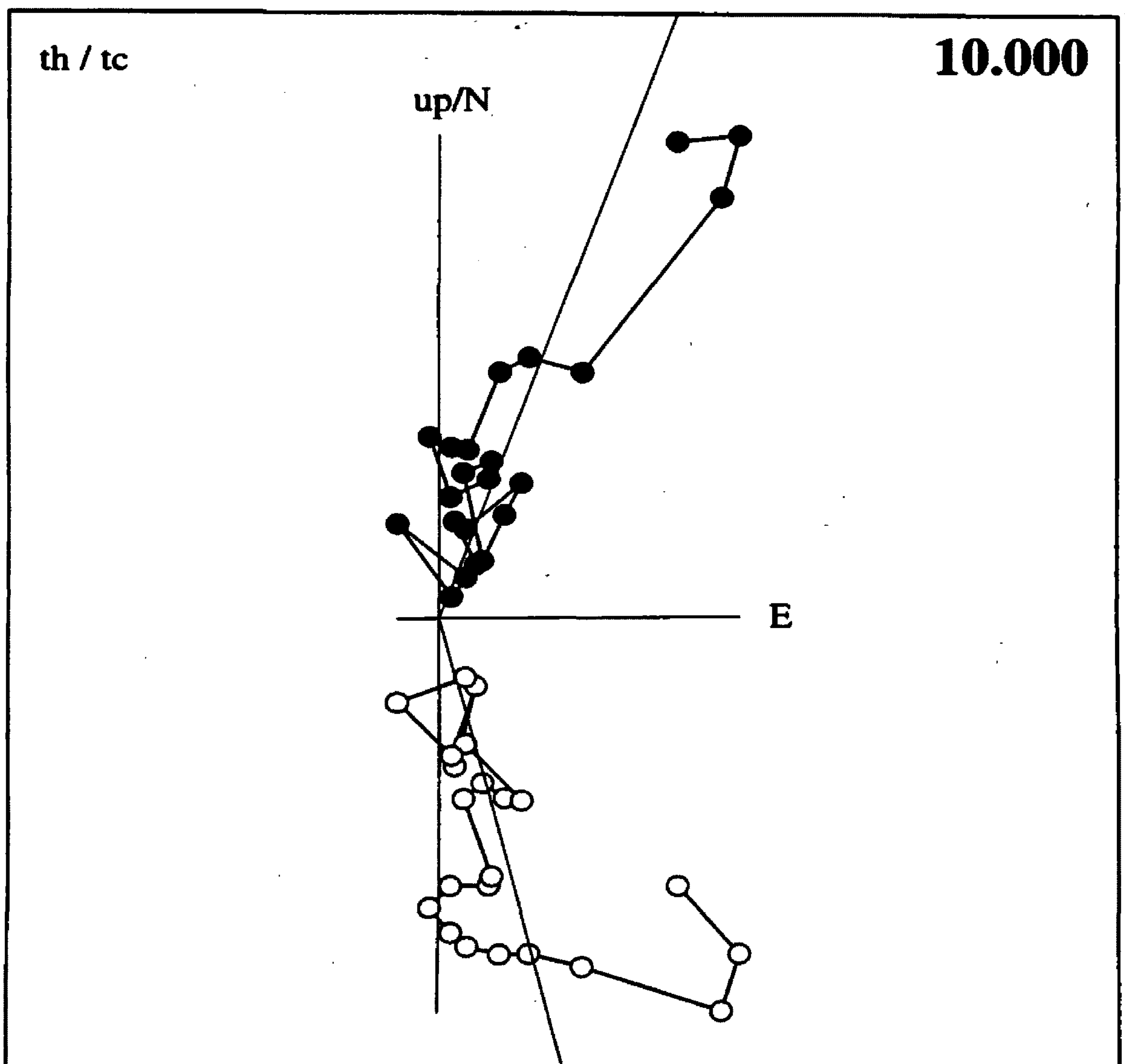
α_{95}=10.15°

k=44.52

δ_{63}=11.10°

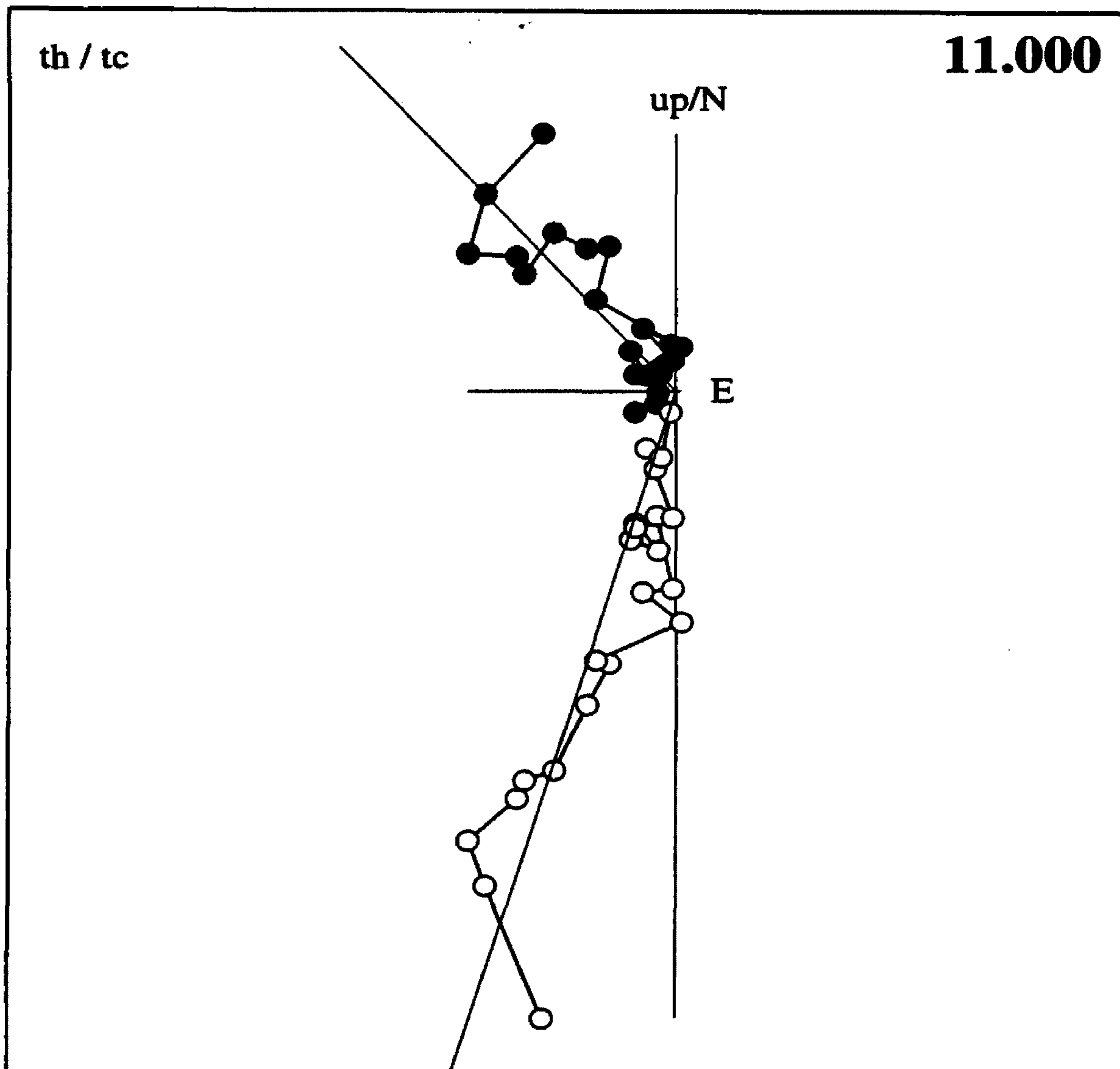
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-740	-6	-120	24.3	27.1	750	1.1		
100	-819	69	-91	29.4	31.1	827	3.0		
200 *	-778	169	-102	31.3	38.4	803	1.0		
300 *	-504	223	-133	27.8	51.2	567	1.5		
350 *	-480	193	-187	17.3	50.6	550	2.4		
400 *	-449	200	-209	12.6	52.9	534	3.6		
450 *	-351	240	-199	8.7	62.4	469	4.3		
500 *	-336	222	-210	3.8	61.2	454	1.6		
530 *	-321	186	-226	357.3	57.7	434	1.3		
545 *	-263	206	-166	4.7	65.5	373	4.8		
555 *	-303	198	-137	17.7	61.2	387	1.2		
565 *	-317	177	-139	16.8	57.5	389	3.4		
575 *	-249	99	-128	8.5	50.8	297	1.6		
585 *	-167	144	-58	34.1	67.3	228	2.1		
595 *	-232	132	-66	29.7	56.7	275	3.9		
615 *	-274	115	-66	28.8	49.9	305	1.5		
635 *	-167	78	-74	14.7	53.8	199	1.4		
645 *	-180	96	-98	8.1	56.7	226	5.0		
655 *	-109	41	-20	31.6	47.0	118	2.4		
665	-100	135	-59	27.8	80.0	178	9.9		
675	-110	22	-125	338.2	39.5	168	2.9		
685	-86	39	-21	30.0	51.5	97	4.7		

INCLOR: dec = 19.6 inc = 53.0 int = 803 mad = 10.8



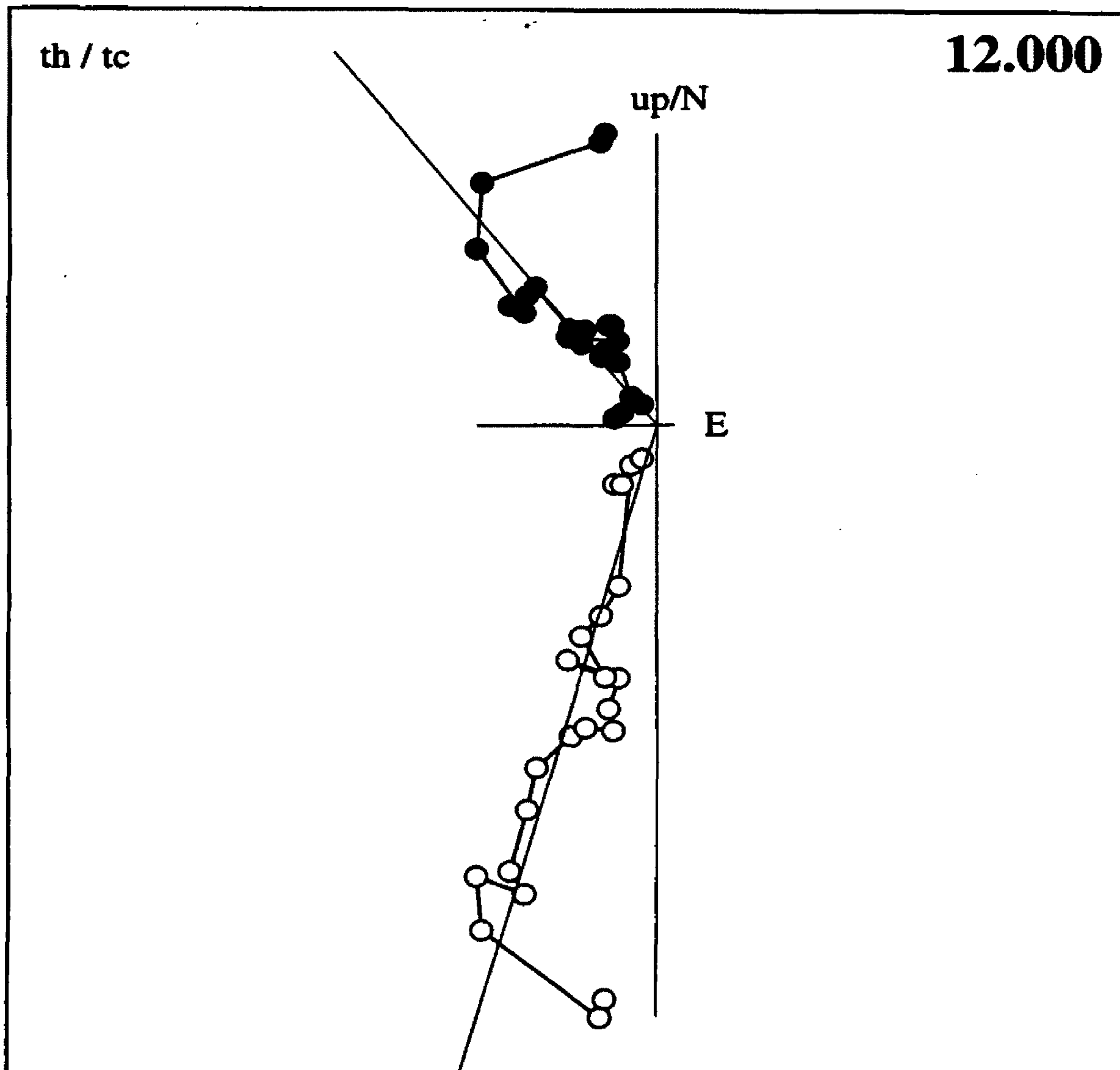
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-836	504	-748	335.0	65.5	1230	2.6		
100 •	-582	400	-706	318.8	62.0	999	3.5		
200 •	-454	412	-665	306.3	62.5	904	4.7		
300 •	-447	364	-568	313.1	64.1	809	5.2		
350 •	-414	361	-535	310.6	65.1	767	5.7		
400 •	-476	301	-512	325.2	63.0	761	4.4		
450 •	-417	235	-416	330.6	62.3	634	1.8		
500 •	-395	179	-359	337.3	59.9	563	1.4		
530 •	-320	238	-343	321.9	66.4	526	2.4		
545 •	-295	252	-169	6.4	79.1	423	3.6		
555 •	-254	186	-214	334.7	70.8	381	2.7		
565 •	-238	223	-150	355.5	81.0	359	0.6		
575 •	-99	179	-100	235.0	80.2	228	2.6		
585 •	-79	198	-129	240.2	72.3	249	3.1		
595 •	-149	211	-127	267.0	84.2	288	2.1		
615 •	-164	145	-184	314.5	68.8	286	3.8		
635 •	-128	158	-155	294.7	73.6	256	3.6		
645 •	-180	114	-114	355.9	70.8	242	2.2		
655 •	-54	55	-88	300.6	61.4	117	8.5		
665 •	-86	79	-91	315.4	71.0	148	8.8		
675 •	-77	65	-74	323.2	71.7	125	-1.9		
685	-72	-30	-50	354.1	24.1	93	3.1		

INCLOR: dec = 318.7 inc = 65.7 int = 999 mad = 8



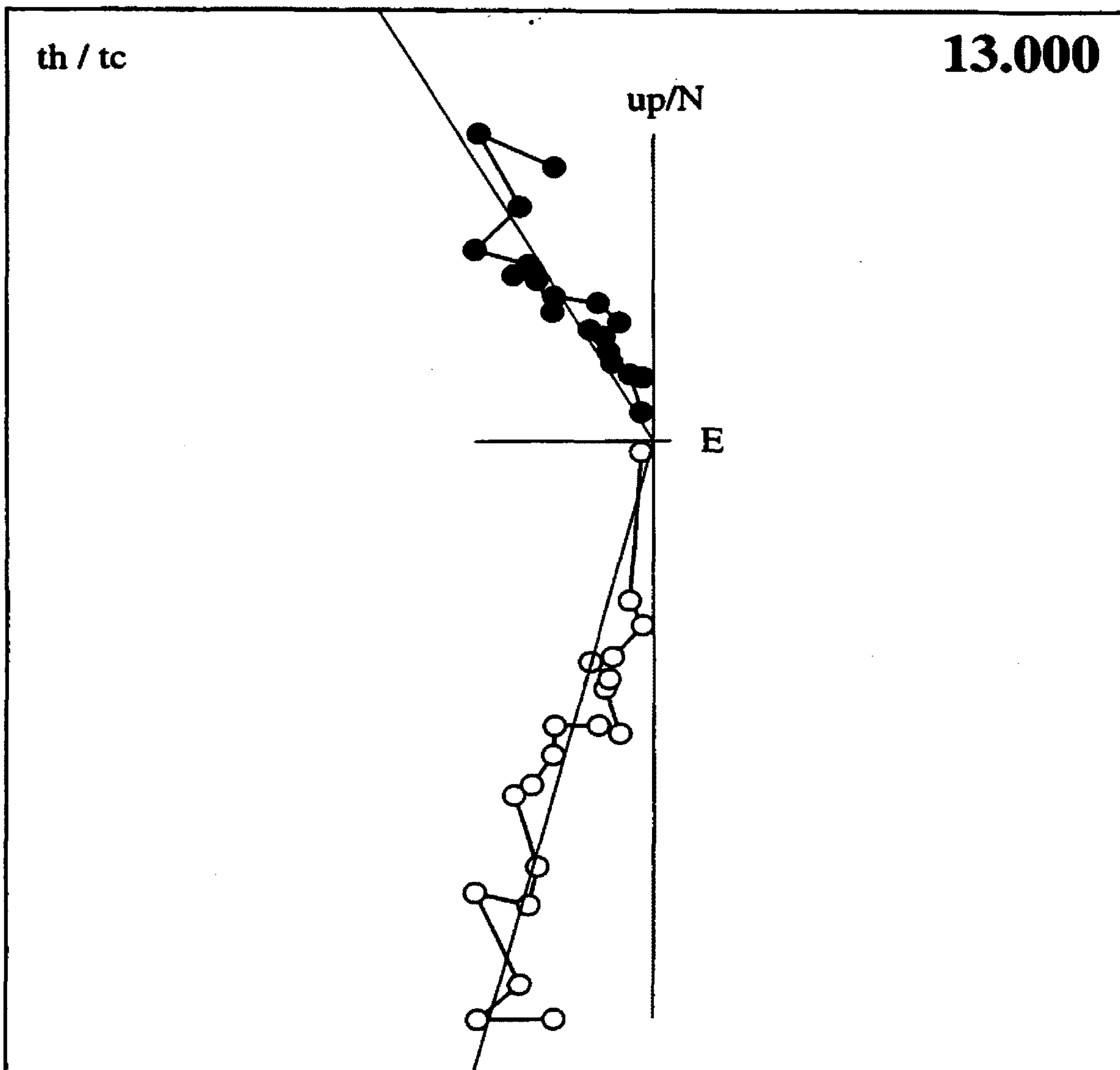
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0		-1284	983	-1035	351.0	62.7	1920	2.2		
100		-1280	1041	-1058	349.8	64.0	1960	3.0		
200	*	-928	837	-1197	327.0	60.1	1730	2.1		
300	*	-705	801	-1083	317.4	61.9	1520	2.1		
350	*	-640	963	-924	313.4	70.6	1480	2.1		
400	*	-610	888	-940	312.2	68.1	1430	1.8		
450	*	-583	728	-847	317.8	65.6	1260	2.2		
500	*	-568	612	-791	321.8	62.8	1150	2.7		
530	*	-478	608	-634	321.1	68.3	1000	3.0		
545	*	-485	593	-589	326.0	69.1	966	4.5		
555	*	-536	603	-533	338.6	70.5	967	2.5		
565	*	-504	548	-520	336.4	68.9	908	3.3		
575	*	-446	498	-449	337.7	70.1	805	2.0		
585	*	-366	428	-550	317.8	63.1	787	1.7		
595	*	-401	506	-468	327.6	70.8	797	0.3		
615	*	-340	381	-486	320.2	63.3	705	3.7		
635	*	-312	356	-405	323.9	65.9	623	7.4		
645	*	-289	298	-327	331.8	66.0	528	3.1		
655	*	-81	47	-132	321.5	47.2	162	11.6		
665		-29	124	-170	279.8	56.4	212	2.5		
675		-54	120	-159	291.5	60.5	206	[illegible]		
685		-68	49	-93	326.9	54.0	125	12.5		

INCLOR: dec = 322.1 inc = 66.0 int = 1730 mad = 4.9



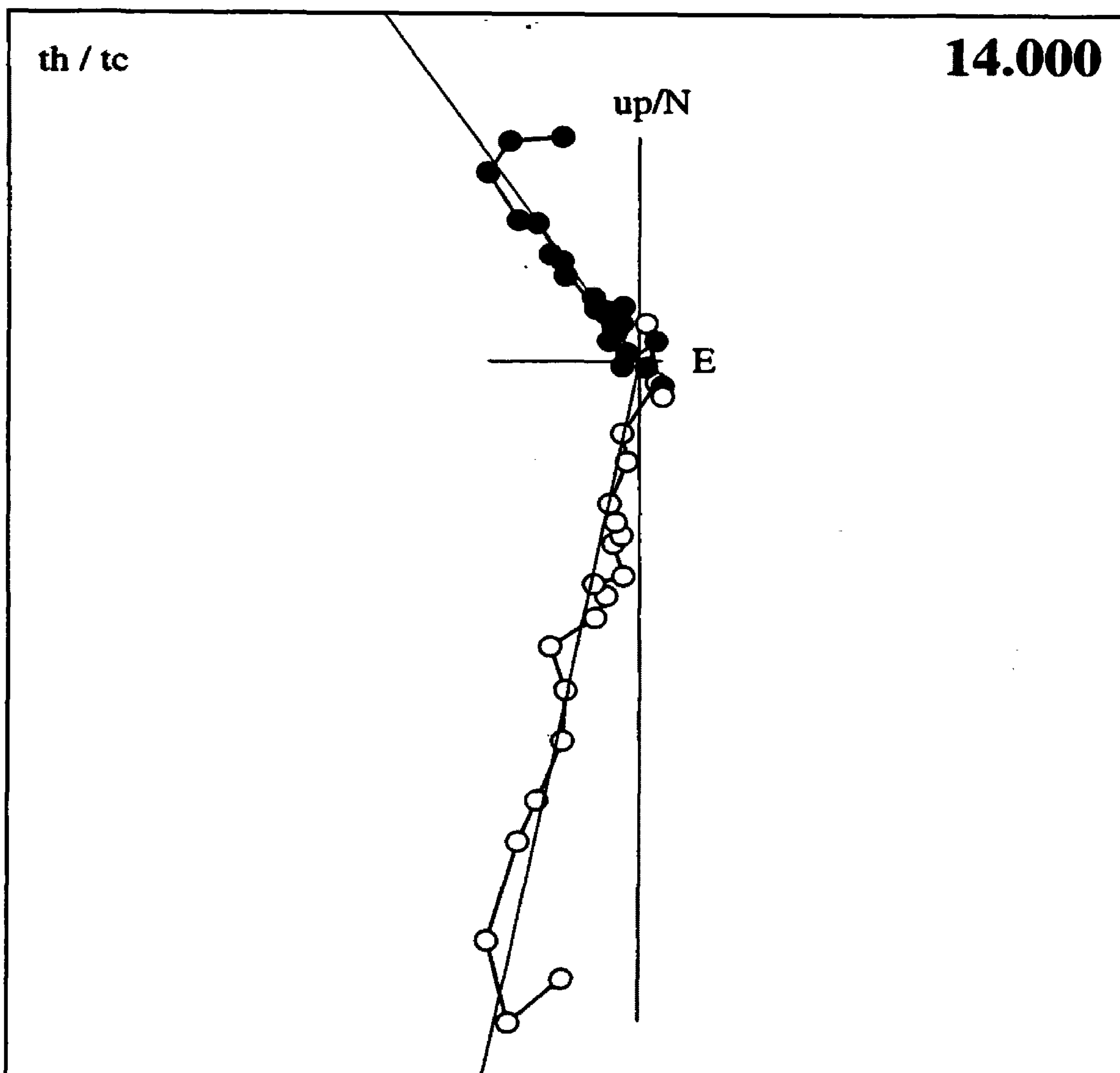
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-752	1300	-1080	341.9	63.4	1850	0.3		
100 *	-773	1217	-1283	332.9	59.0	1930	1.2		
200 *	-608	1200	-1087	332.8	64.0	1730	2.0		
300 *	-435	943	-1054	320.0	60.9	1480	1.4		
350 *	-446	1030	-934	327.4	65.6	1460	1.2		
400 *	-406	945	-859	327.0	65.6	1340	2.5		
450 *	-385	732	-842	322.8	59.4	1180	4.0		
500 *	-418	716	-797	327.5	59.0	1150	4.8		
530 *	-313	680	-678	324.9	63.3	1010	2.6		
545 *	-352	596	-657	328.3	59.1	954	2.5		
555 *	-377	636	-551	340.4	62.5	922	3.3		
565 *	-344	686	-495	345.6	67.2	913	3.7		
575 *	-283	561	-469	337.0	65.3	784	2.9		
585 *	-244	548	-437	335.6	67.5	742	1.2		
595 *	-284	475	-479	332.9	60.3	732	4.4		
615 *	-213	499	-395	334.4	68.0	671	0.8		
635 *	-196	449	-278	351.4	70.7	563	1.1		
645 *	-187	370	-284	342.1	66.3	502	1.2		
655 *	-68	3	-65	339.1	19.5	94	18.1		

INCLOR: dec = 330.1 inc = 62.7 int = 1929 mad = 4.3



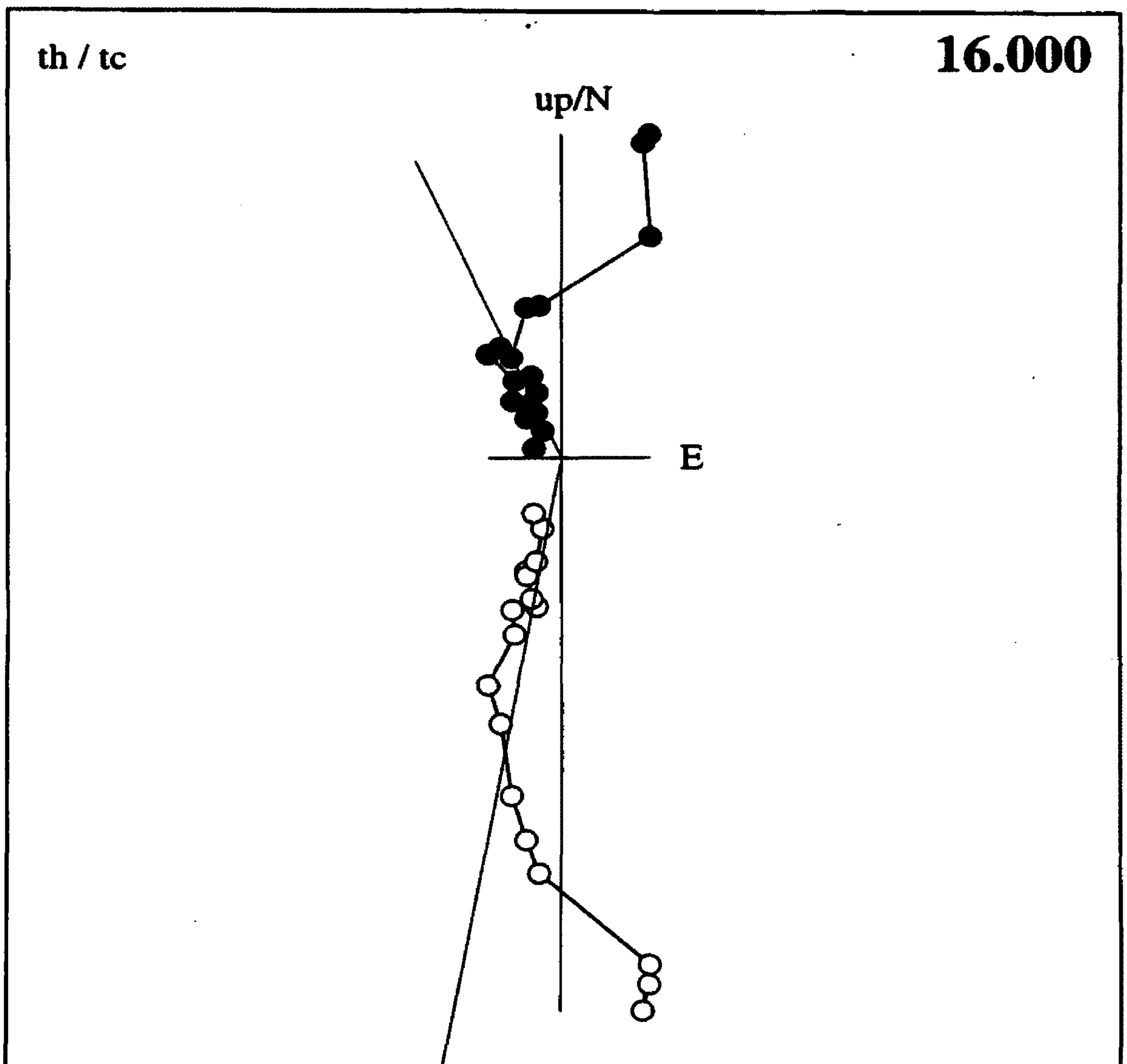
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1234	1362	-1116	342.8	69.1	2150	2.4		
100 •	-1232	1428	-1317	332.0	69.2	2300	1.0		
200 •	-1043	1211	-1251	324.1	67.9	2030	1.7		
300 •	-823	1030	-1025	322.3	69.5	1670	1.4		
350 •	-785	941	-917	326.2	69.2	1530	2.8		
400 •	-627	850	-758	325.4	72.1	1300	2.0		
450 •	-536	729	-676	322.2	71.6	1130	4.4		
500 •	-550	568	-660	323.2	64.8	1030	4.1		
530 •	-385	603	-489	323.4	75.5	867	2.5		
545 •	-353	562	-429	327.8	76.6	790	2.1		
555 •	-384	495	-449	327.1	71.1	771	3.7		
565 •	-368	518	-358	345.3	75.1	729	1.7		
575 •	-272	437	-334	326.9	76.7	614	5.1		
585 •	-275	423	-301	337.3	76.8	587	4.5		
595 •	-229	390	-297	322.9	77.5	541	0.5		
615 •	-184	338	-286	307.3	76.4	480	5.0		
635 •	-116	255	-176	307.1	82.0	331	7.4		
645 •	-44	187	-146	251.9	77.4	241	5.4		
655 •	-93	56	12	38.1	40.1	109	5.9		
665	53	-90	75	135.0	-76.1	128	5.2		
675	29	155	15	140.7	47.5	158	9.0		

INCLOR: dec = 326.5 inc = 70.4 int = 2299 mad = 3.6



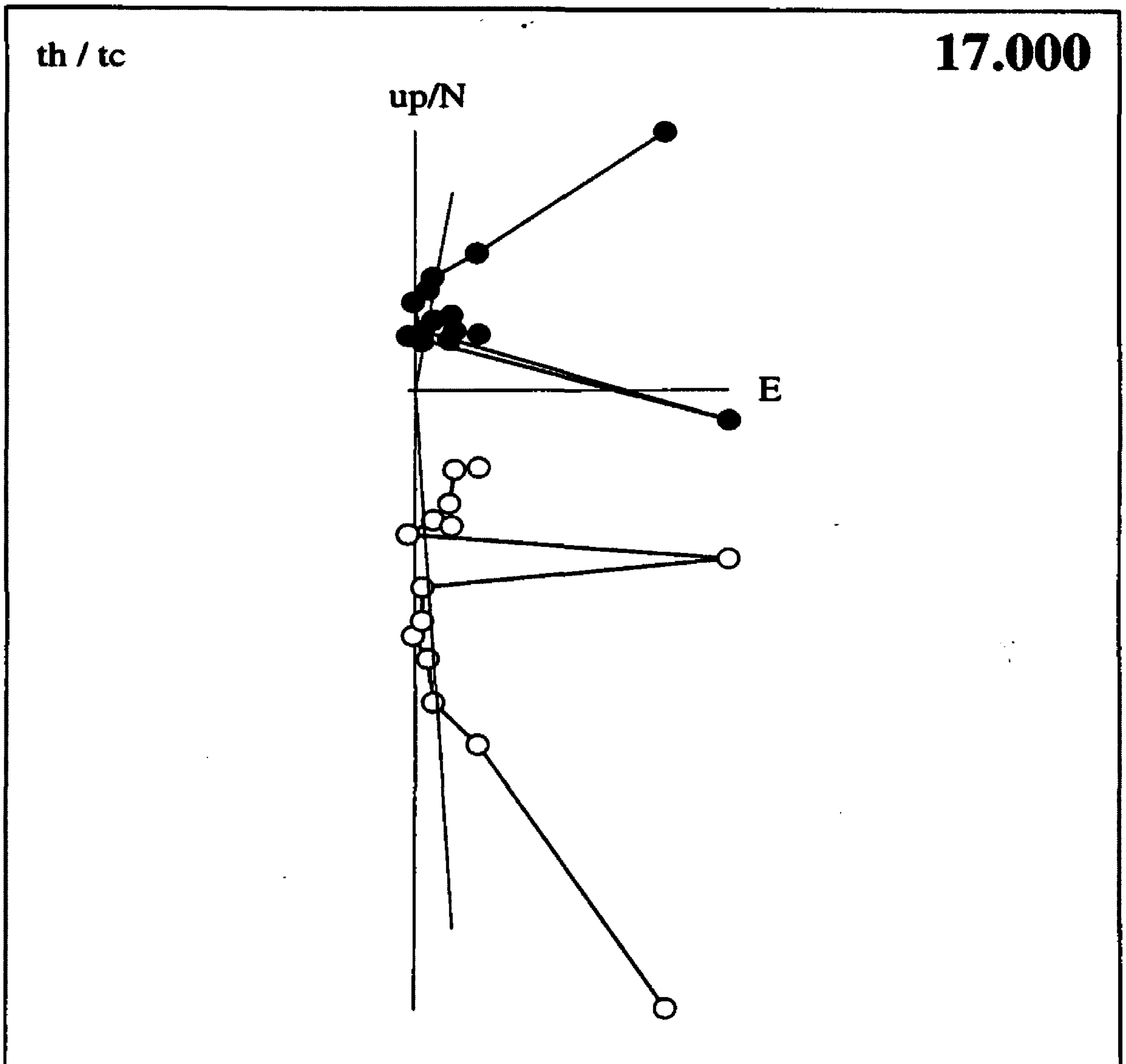
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1838	999	-712	13.9	57.5	2210	1.9		
100	-1842	1087	-761	13.3	59.6	2270	2.3		
200	-1505	1131	-614	20.0	65.0	1980	1.1		
300	-1037	903	-757	352.7	69.7	1570	0.8		
350 •	-967	799	-747	348.1	68.1	1460	2.3		
400 •	-736	752	-694	335.7	72.0	1260	0.8		
450 •	-647	515	-630	333.3	65.1	1040	1.5		
500 •	-558	407	-605	327.4	61.6	918	3.9		
530 •	-435	333	-441	331.0	63.7	703	4.8		
545 •	-336	297	-398	321.8	64.8	600	3.7		
555 •	-385	293	-328	341.2	65.3	585	1.9		
565 •	-418	235	-343	341.8	58.7	589	1.1		
575 •	-244	228	-291	321.1	66.0	443	5.2		
585 •	-290	219	-305	329.0	62.9	474	2.8		
595 •	-258	199	-252	333.1	64.3	412	2.2		
615 •	-165	142	-174	328.4	66.0	279	4.1		
635 •	-79	122	-167	290.8	64.5	222	4.6		

INCLOR: dec = 336.0 inc = 66.8 int = 1460 mad = 5.1



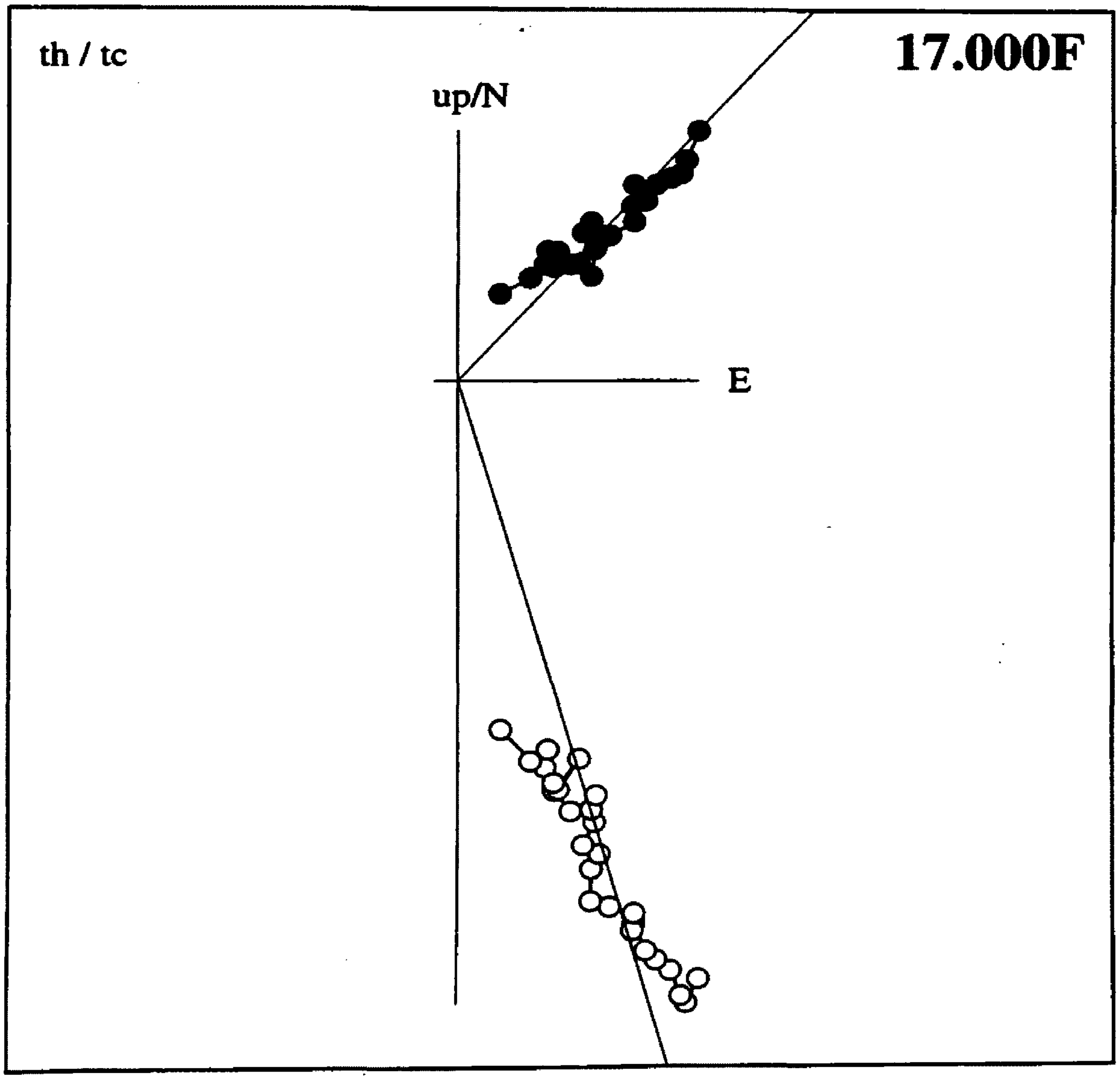
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1375	1042	-348	41.1	60.9	1760	1.0		
100	-652	620	-324	22.2	67.3	956	2.2		
200	-507	559	-337	8.0	70.0	827	6.7		
300 *	-439	478	-299	6.6	69.4	714	3.9		
350 *	-375	441	-291	359.0	70.2	648	3.3		
400 *	-309	453	-208	7.8	78.0	586	4.2		
450 *	-295	366	-200	6.8	73.2	511	1.1		
500	-563	374	475	96.0	30.7	826	2.5		
530 *	-216	257	-185	353.3	69.2	383	0.6		
545 *	-266	206	-156	13.2	61.0	371	4.3		
555 *	-306	211	-134	23.9	58.9	395	1.4		
565 *	-241	190	-88	31.7	62.5	319	2.8		
575 *	-230	104	-70	31.0	49.1	262	1.8		
585	-258	101	-22	46.0	44.1	278	1.0		

INCLOR: dec = 9.6 inc = 69.5 int = 714 mad = 7.4



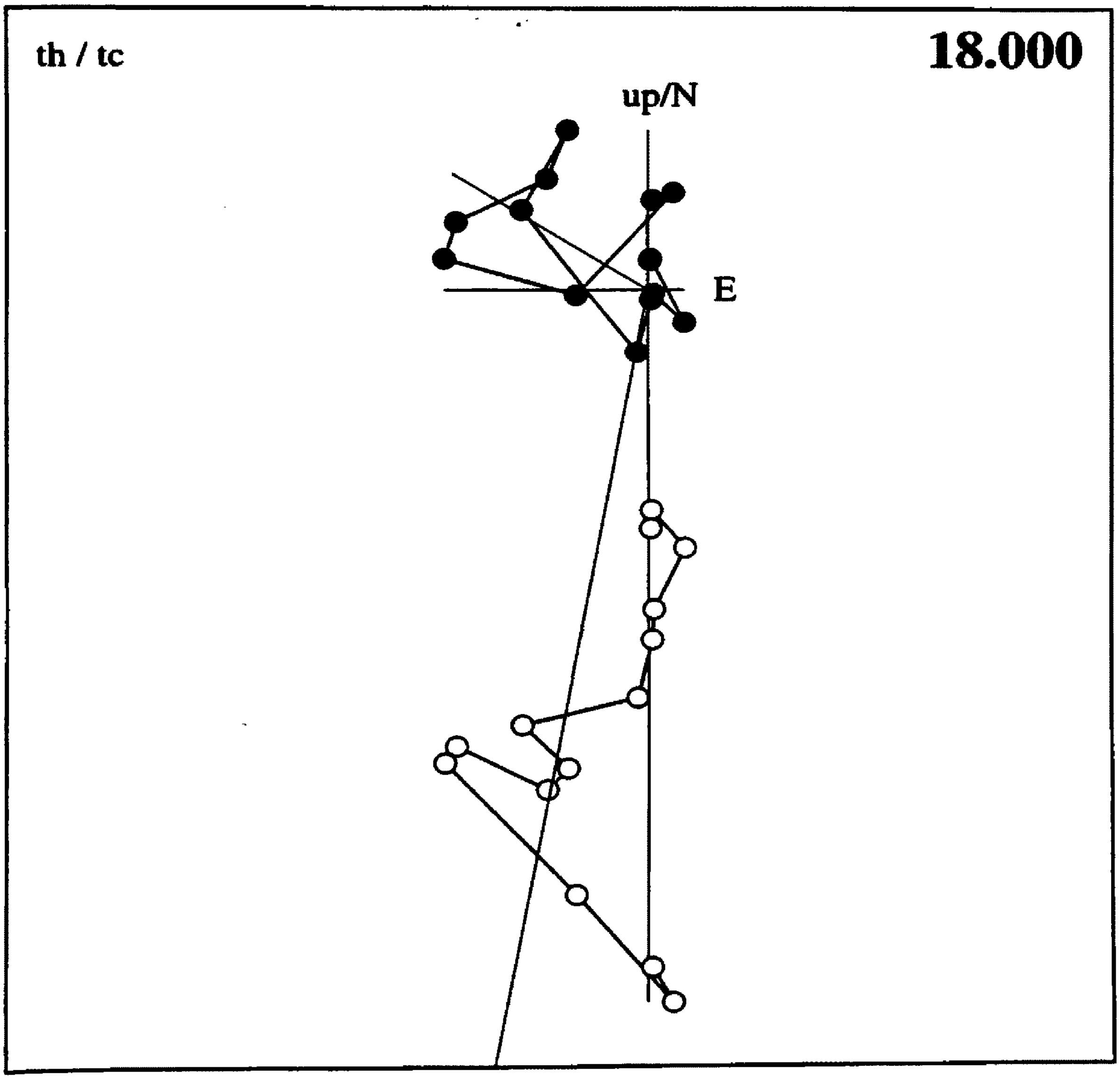
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1375	1042	-348	41.1	60.9	1760	1.0		
2 *	-1330	1133	-343	43.1	64.0	1780	0.7		
4 *	-1293	1133	-327	44.3	64.7	1750	1.3		
6 *	-1244	1082	-321	43.6	64.5	1680	3.2		
8 *	-1201	1067	-330	42.5	65.2	1640	2.8		
10 *	-1148	1068	-319	43.4	66.4	1600	1.1		
12 *	-1131	987	-346	39.1	65.0	1540	2.5		
14 *	-1100	1028	-323	42.0	66.7	1540	2.8		
16 *	-1060	1008	-284	45.0	66.9	1490	2.7		
18 *	-993	1013	-302	43.3	69.1	1450	1.3		
20 *	-969	995	-342	38.4	69.5	1430	1.1		
24 *	-951	914	-331	37.2	67.7	1360	3.6		
28 *	-928	894	-287	41.1	67.6	1320	2.3		
32 *	-897	872	-313	37.3	68.0	1290	4.1		
36 *	-862	840	-252	43.2	67.8	1230	2.8		
40 *	-800	841	-210	48.8	69.5	1180	1.5		
46 *	-846	773	-237	42.7	66.0	1170	6.3		
52 *	-791	834	-266	40.9	70.2	1180	3.6		
58 *	-741	793	-276	37.4	70.7	1120	4.4		
64 *	-754	713	-217	42.9	66.9	1060	4.9		
70 *	-772	771	-292	35.0	68.9	1130	4.5		
78 *	-708	737	-281	34.0	70.1	1060	4.9		
86 *	-720	679	-286	31.8	67.3	1030	3.5		
94 *	-658	740	-283	32.3	72.1	1030	3.6		
102 *	-733	773	-273	37.0	70.3	1100	3.2		
112 *	-555	689	-291	23.6	74.6	932	3.8		
	-572	673	-317	19.2	72.9	939	5.3		
----	-658	619	-273	30.0	67.3	944	5.8		

INCLOR: dec = 41.0 inc = 66.9 int = 1760 mad = 3.1



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-372	590	-272	2.7	82.4	749	1.2		
100	-405	619	-271	13.3	82.0	788	1.9		
200	-223	574	-259	265.5	83.9	668	3.0		
300 *	-118	426	-341	279.6	68.4	558	7.6		
350 *	-145	390	-346	291.2	67.8	541	2.9		
400 *	-250	409	-310	320.3	74.0	571	0.8		
450 *	-291	363	-312	335.5	69.9	560	3.5		
500 *	-183	365	-292	304.8	72.3	502	1.5		
530 *	-125	422	-113	189.1	81.1	455	3.0		
545 *	-151	338	-110	160.1	88.4	386	4.0		
555 *	-143	306	-102	124.3	88.9	353	1.3		
565 *	-110	265	-40	134.7	79.8	290	5.6		
575 *	-124	193	-89	4.4	82.0	246	1.3		
585 *	-131	211	-95	4.3	82.9	266	6.2		

INCLOR: dec = 303.1 inc = 78.0 int = 558 mad = 11.7



Ford Creek 4

Specimens:

19, 20, 21 & 23 (avg), 22, 25 & 25B, 26 & 26B, 27 & 27B

In-situ:

Dec=7.51°, Inc=57.08°

α_{95}=5.21°

k=135.05

δ_{63}=6.46°

Structurally corrected:

Dec=-7.06°, Inc=55.05°

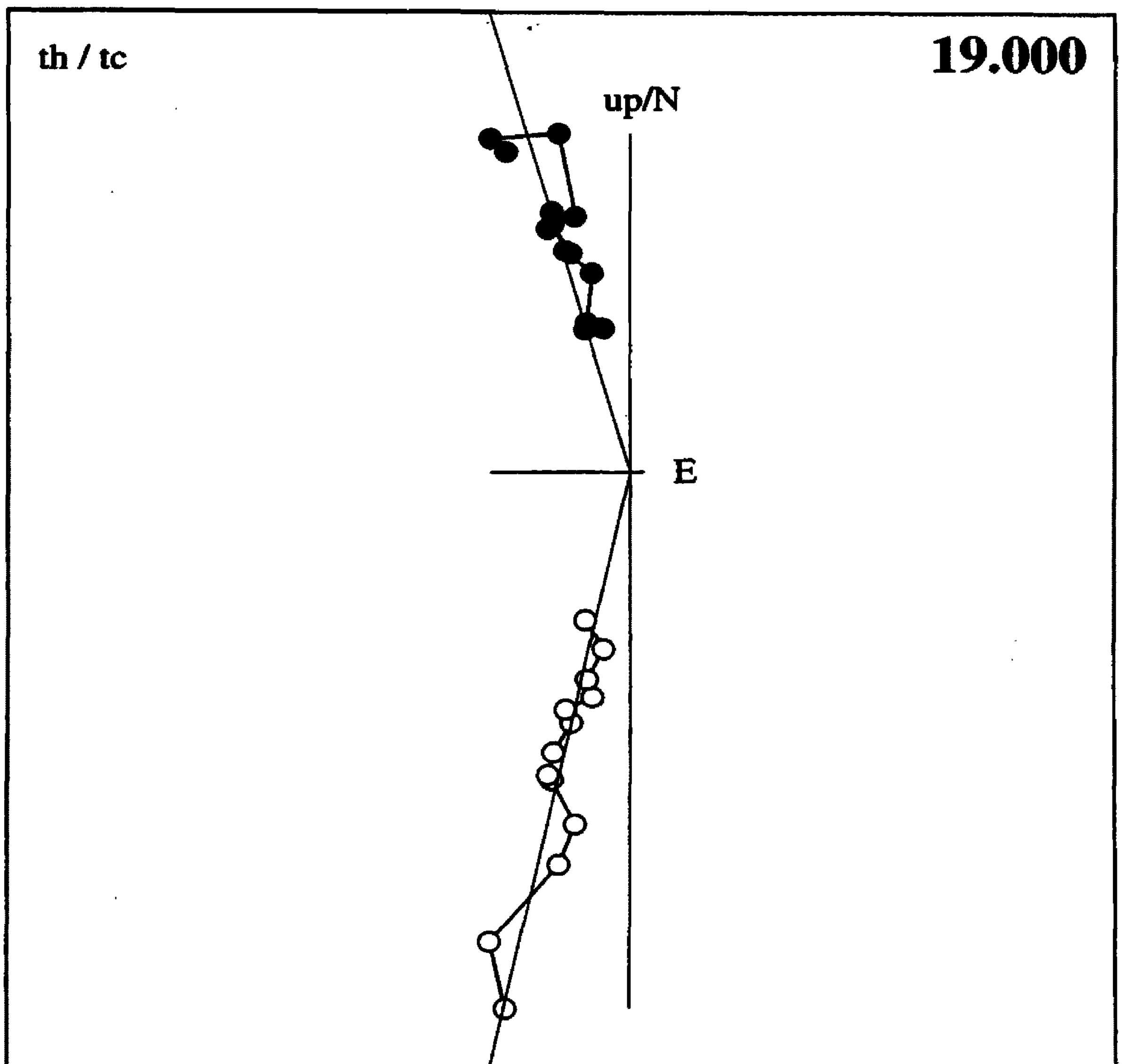
α_{95}=5.18°

k=136.74

δ_{63}=6.42°

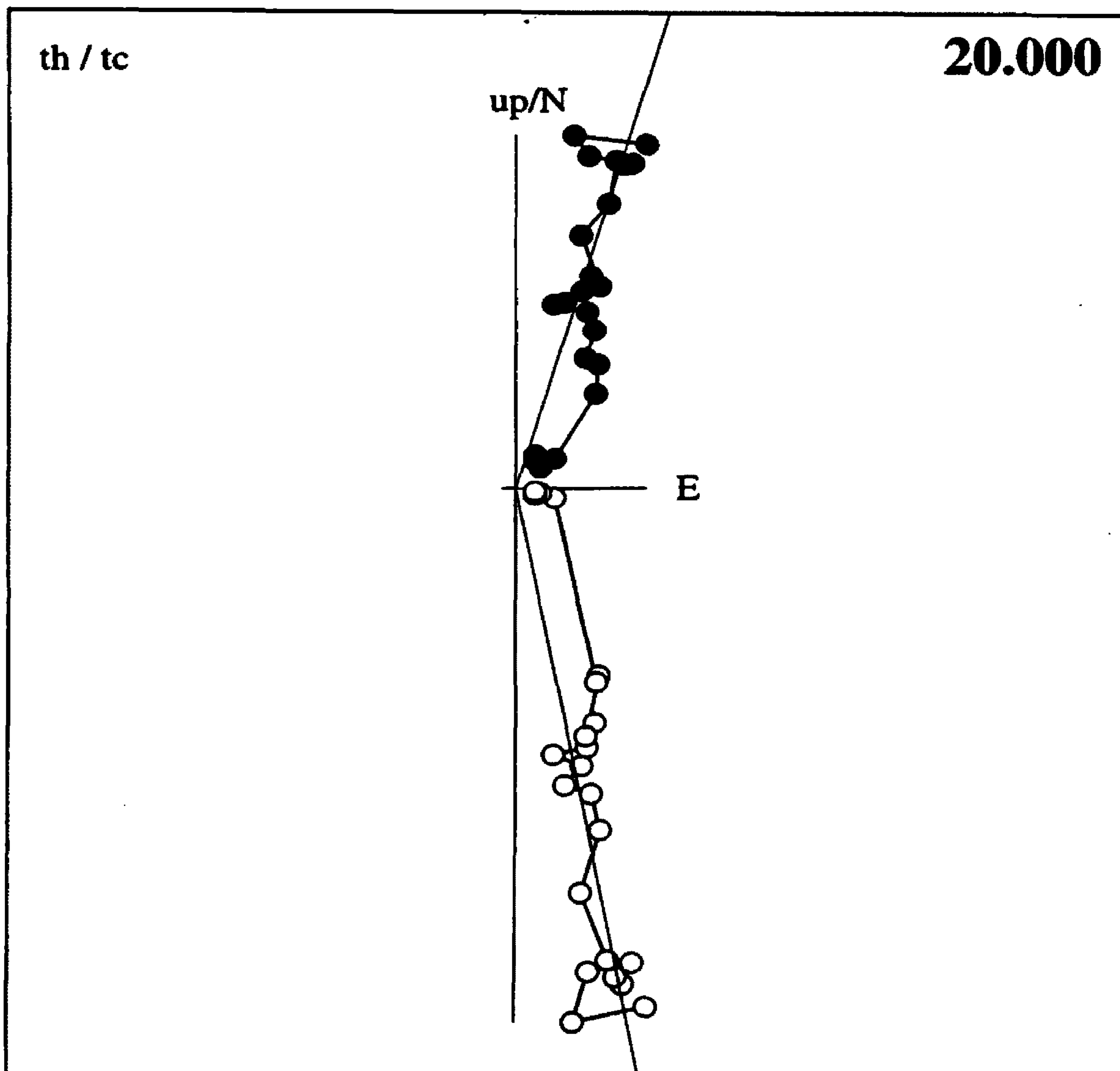
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
----	-817	477	-198	261.3	64.4	967	4.4		
----	-857	560	-180	261.4	67.8	1040	2.6		
----	-733	424	17	292.6	68.3	847	4.4		
----	-599	330	247	335.2	61.6	727	3.4		
----	-644	415	378	349.9	60.0	854	3.0		
400 *	-922	473	475	340.7	57.5	1140	3.4		
450 *	-874	357	481	339.3	52.5	1060	2.2		
500 *	-711	308	532	349.3	48.5	940	2.4		
530 *	-601	311	404	349.0	53.4	788	4.0		
545 *	-582	225	392	344.8	48.6	737	1.8		
555 *	-572	224	361	343.0	49.8	713	3.5		
565 *	-543	196	370	344.3	47.4	686	2.3		
575 *	-473	185	334	346.3	47.9	608	2.7		
585 *	-466	159	334	345.2	45.9	595	4.1		
595 *	-408	178	314	350.2	48.0	545	3.2		
615 *	-366	175	229	345.4	53.3	466	4.0		
635 *	-311	149	229	350.4	50.3	414	5.2		
645 *	-299	94	212	344.1	45.0	378	7.7		

INCLOR: dec = 344.6 inc = 51.3 int = 1140 mad = 4.4



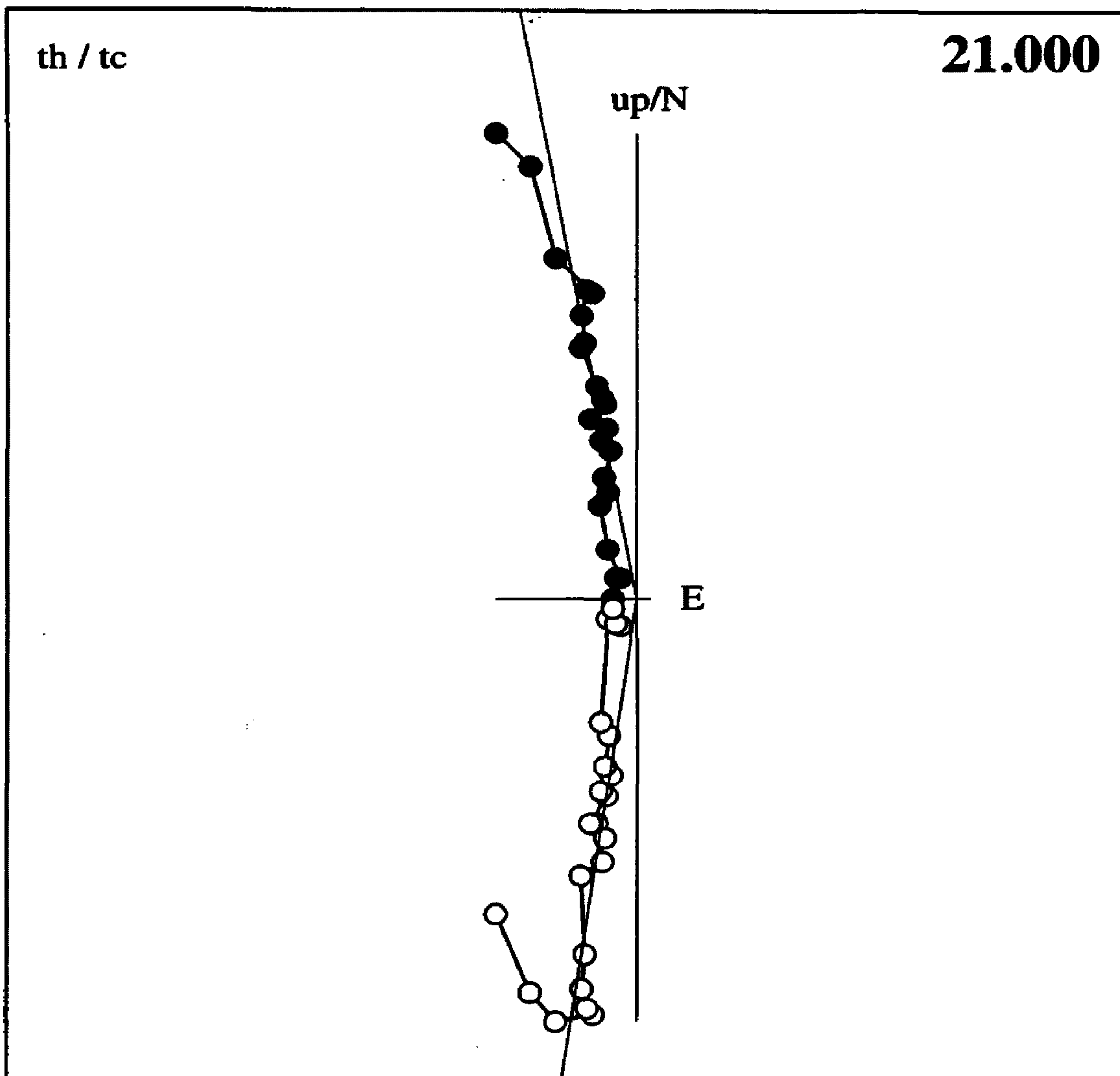
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	*	-2143	1133	570	19.0	54.7	2490	1.3		
100	*	-2175	1230	323	8.5	56.0	2520	1.7		
200	*	-2024	1078	354	11.3	54.7	2320	2.1		
300	*	-1996	1024	505	18.0	54.0	2300	2.3		
350	*	-2026	1107	488	16.7	55.4	2360	0.5		
400	*	-2025	1082	455	15.5	54.9	2340	2.0		
450	*	-1841	1099	447	16.4	57.6	2190	0.6		
500	*	-1607	939	327	13.1	57.0	1890	2.4		
530	*	-1325	789	385	20.6	57.5	1590	2.9		
545	*	-1298	656	325	17.9	53.6	1490	4.0		
555	*	-1182	609	244	13.4	56.9	1390	4.0		
565	*	-1193	590	282	16.8	53.2	1360	4.1		
575	*	-1118	595	185	10.4	54.6	1280	4.6		
585	*	-1090	555	301	20.0	53.8	1260	2.4		
595	*	-986	496	324	24.2	53.4	1150	2.2		
615	*	-908	591	323	26.0	59.4	1130	1.3		
635	*	-787	383	329	31.0	52.1	935	2.8		
645	*	-692	454	345	37.3	58.2	897	3.3		
655	*	-132	-47	120	49.8	11.4	185	4.0		
665	*	-89	-39	75	47.3	8.0	123	11.5		
675	*	-113	-40	52	32.5	10.1	131	14.8		
685	*	-130	-61	46	27.4	4.1	151	14.5		

INCLOR: dec = 16.2 inc = 55.5 int = 2490 mad = 3.6



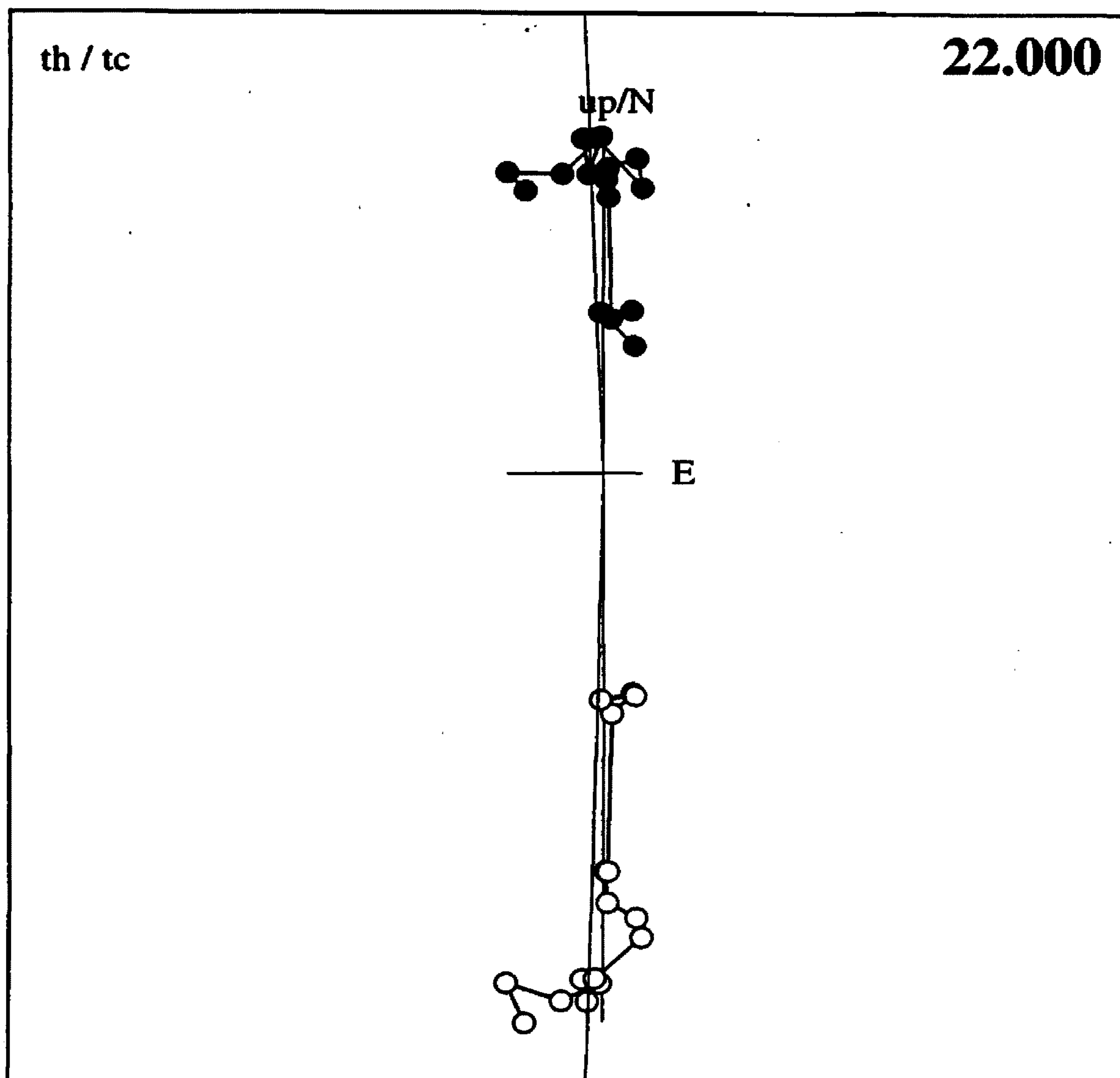
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-2425	-673	-861	344.7	32.9	2660	2.1		
100	-2628	-399	-624	347.4	41.3	2730	2.5		
200 *	-2489	-33	-390	347.9	50.2	2520	0.0		
300 *	-2371	26	-207	352.6	53.1	2380	1.4		
350 *	-2358	5	-240	351.7	52.3	2370	1.3		
400 *	-2216	55	-245	350.1	53.3	2230	0.4		
450 *	-2016	62	-229	349.6	53.5	2030	2.1		
500 *	-1710	-112	-300	348.6	47.1	1740	2.1		
530 *	-1521	4	-163	351.3	52.2	1530	2.4		
545 *	-1415	-131	-234	350.2	45.9	1440	1.4		
555 *	-1420	-41	-168	351.5	50.3	1430	1.6		
565 *	-1322	-5	-219	346.8	50.4	1340	1.5		
575 *	-1197	-65	-164	351.0	48.6	1210	0.9		
585 *	-1146	-25	-179	348.3	49.7	1160	2.8		
595 *	-1060	-42	-139	350.9	49.5	1070	1.1		
615 *	-953	39	-139	346.4	53.1	964	0.6		
635 *	-798	5	-130	346.6	51.0	809	1.4		
645 *	-712	30	-159	340.4	51.0	730	2.1		
655 *	-207	-90	-158	332.4	19.2	276	2.7		
665 *	-156	15	-68	325.2	46.1	171	3.4		
675 *	-150	13	-87	319.4	40.9	174	4.8		
685 *	-37	53	-86	271.4	24.4	108	12.2		

INCLOR: dec = 349.8 inc = 51.2 int = 2520 mad = 3



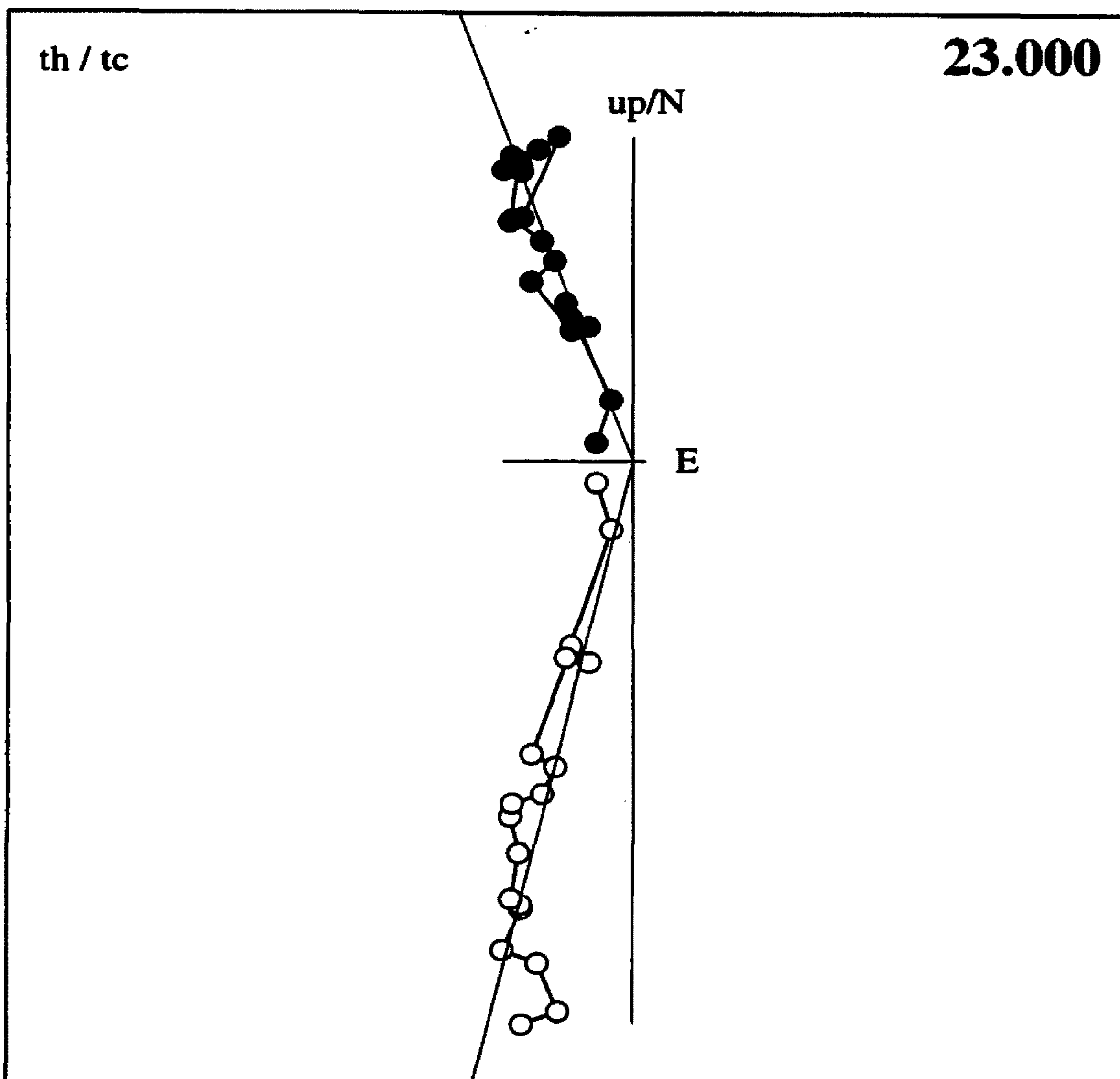
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
----	869	-1823	946	49.4	-49.5	2230	1.6		
100 *	-1291	331	140	346.0	61.8	1340	1.6		
200 *	-1263	243	98	343.9	58.1	1290	1.8		
300 *	-1264	274	209	352.9	60.0	1310	2.1		
350 *	-1274	190	290	359.6	56.4	1320	2.1		
400 *	-1254	275	259	357.4	60.2	1310	0.8		
450 *	-1272	187	253	356.8	56.3	1310	1.6		
500 *	-1267	186	278	358.9	56.2	1310	1.3		
530 *	-1112	208	336	7.1	58.0	1180	1.5		
545 *	-1126	133	329	5.5	54.4	1180	1.3		
555 *	-1102	127	264	0.7	54.5	1140	3.6		
565 *	-1037	100	245	0.4	53.5	1070	1.7		
575 *	-1013	129	244	0.8	55.1	1050	2.8		
585 *	-592	98	154	2.8	57.2	620	2.3		
605 *	-563	57	188	9.1	53.1	596	1.2		
625 *	-585	67	130	359.0	54.5	603	1.4		
645 *	-516	117	182	12.5	59.5	559	2.6		
----	-912	590	-1120	268.9	34.1	1560	6.6		
----	377	948	-899	215.5	9.0	1360	6.7		
----	-5	-97	-19	344.1	-40.6	99	227.0		

INCLOR: dec = 357.8 inc = 57.4 int = 1339 mad = 4.4



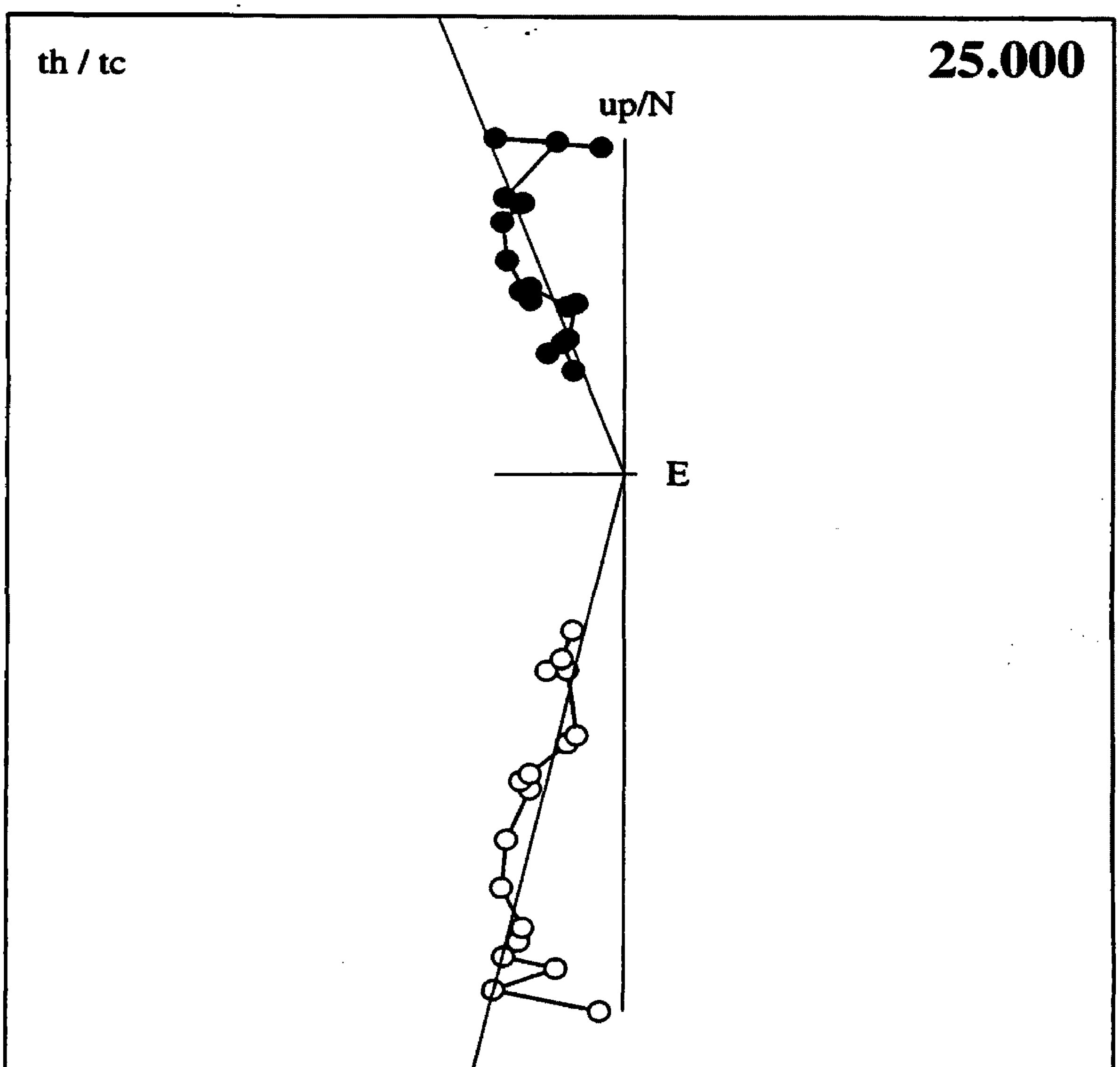
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1932	1531	-943	337.7	64.7	2640	1.2		
100 •	-1925	1429	-1305	348.3	58.7	2730	1.4		
200 •	-1710	1408	-1243	344.5	57.0	2540	1.5		
300 •	-1605	1492	-1139	338.1	57.0	2470	1.5		
350 •	-1480	1356	-1143	340.7	55.4	2310	2.5		
400 •	-1462	1353	-1169	341.0	54.6	2310	2.0		
450 •	-1421	1381	-1206	340.2	53.2	2320	1.2		
500 •	-1261	1270	-1192	341.1	50.8	2150	2.2		
530 •	-1121	1203	-932	335.1	53.2	1890	1.4		
545 •	-1073	1175	-943	335.6	52.0	1850	1.5		
555 •	-1091	1040	-870	339.6	54.6	1740	2.7		
565 •	-1012	936	-793	340.6	55.0	1590	2.4		
575 •	-930	983	-693	333.0	55.3	1520	3.8		
585 •	-601	628	-514	337.0	52.8	1010	2.9		
605 •	-679	591	-540	343.8	54.9	1050	3.7		
625 •	-585	628	-569	339.0	50.0	1030	5.9		
645 •	-619	676	-626	339.2	49.1	1110	3.7		
----	-397	939	-1686	346.1	21.9	1970	0.2		
665 •	-217	234	-247	342.5	46.4	403	25.5		
675 •	-20	177	-59	299.6	29.3	188	52.2		
----	-301	296	467	205.0	39.9	629	18.7		

INCLOR: dec = 340.6 inc = 54.9 int = 2729 mad = 3.4



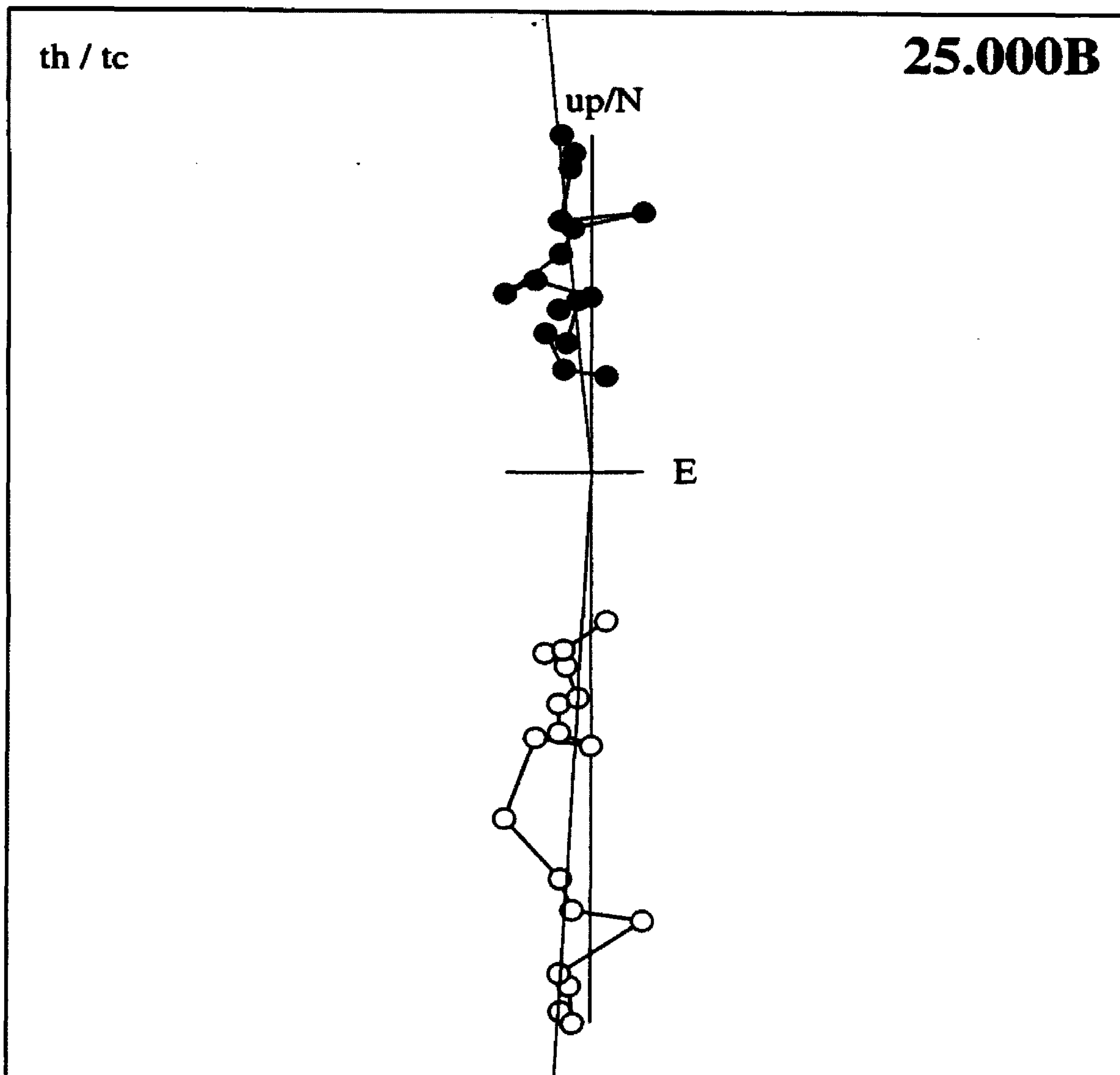
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1031	1796	284	356.4	58.4	2090	1.5		
100 *	-1080	1777	-45	340.8	55.1	2080	1.1		
200 *	-1061	1678	129	349.6	55.4	1990	0.8		
300 *	-882	1660	-42	338.6	58.2	1880	2.5		
350 *	-863	1602	-9	340.7	58.2	1820	0.7		
400 *	-866	1555	-3	341.5	57.5	1780	1.0		
450 *	-810	1435	-91	336.5	56.1	1650	0.6		
500 *	-688	1272	-110	333.8	56.6	1450	1.8		
530 *	-557	1094	-75	334.1	58.2	1230	3.9		
545 *	-592	1073	-108	333.0	55.8	1230	1.2		
555 *	-603	1046	-82	335.6	55.3	1210	1.4		
565 *	-537	926	7	342.9	56.7	1070	2.9		
575 *	-546	896	31	345.8	55.8	1050	3.9		
585 *	-437	685	-36	339.4	53.5	813	2.8		
605 *	-392	695	-99	330.2	54.5	804	1.5		
625 *	-426	650	-58	337.1	52.2	780	4.2		
645 *	-335	549	-48	336.0	53.8	645	3.7		
----	-2535	75	133	0.2	0.2	2540	4.1		
----	625	1048	9	193.4	59.9	1220	12.8		
----	569	-279	-1348	242.9	-18.9	1490	12.5		

INCLOR: dec = 339.8 inc = 56.5 int = 2079 mad = 3



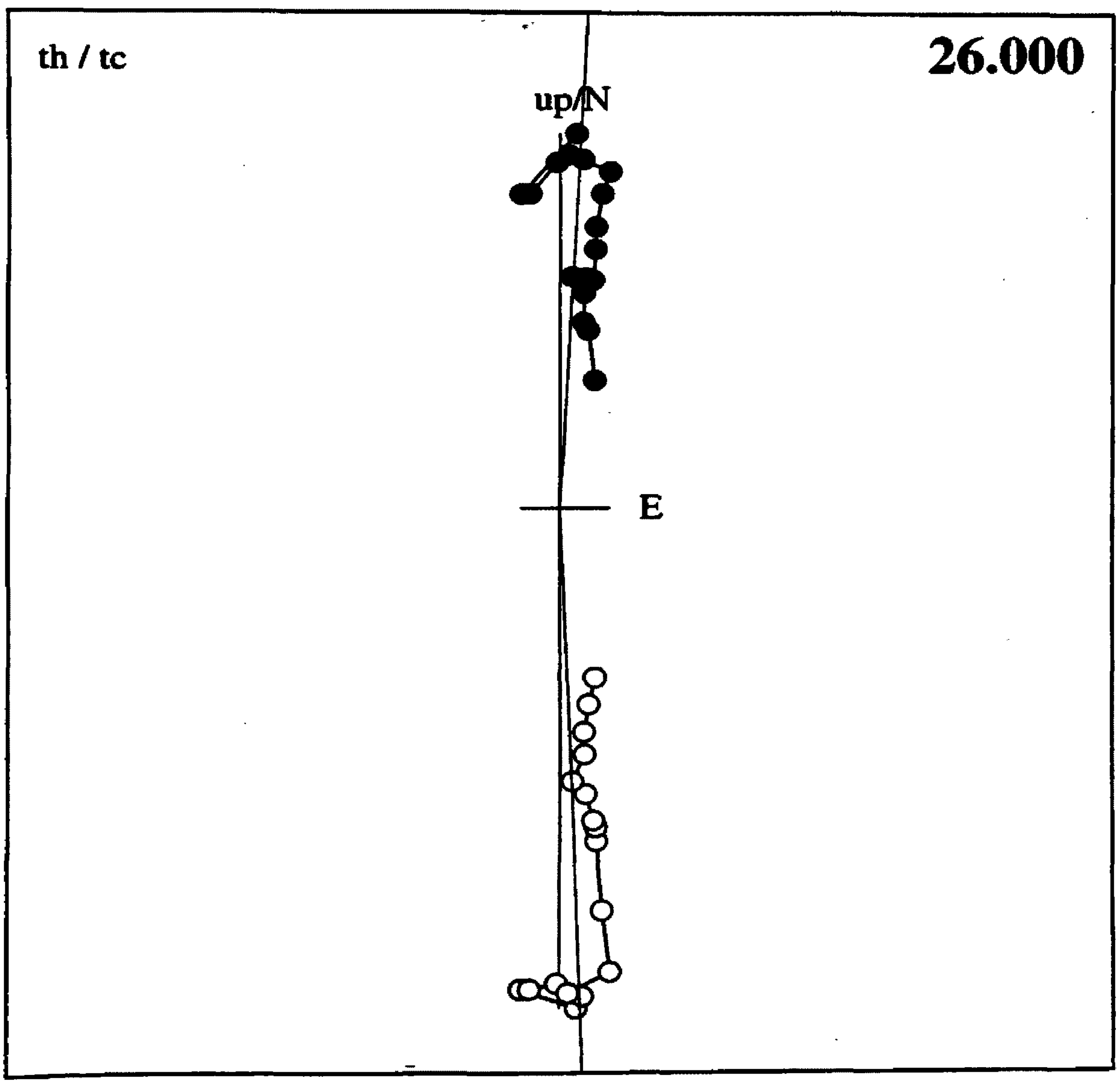
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-986	1665	244	355.4	57.6	1950	1.1		
100 *	-926	1693	282	357.2	59.6	1950	3.2		
200 *	-885	1582	251	356.4	59.1	1830	3.0		
300 *	-727	1545	209	353.6	62.9	1720	1.2		
350 *	-747	1353	413	10.2	59.3	1600	2.5		
400 *	-708	1351	212	356.1	60.6	1540	2.9		
450 *	-634	1261	158	352.8	61.4	1420	3.7		
500 *	-524	1101	-32	336.4	60.4	1220	2.4		
530 *	-572	845	12	345.3	52.9	1020	2.8		
545 *	-511	844	166	359.8	57.2	1000	4.5		
555 *	-477	816	69	349.8	57.4	948	4.1		
565 *	-482	730	53	349.7	54.2	877	4.2		
575 *	-508	704	105	355.9	52.4	874	3.2		
585 *	-381	610	51	350.2	55.8	721	3.2		
605 *	-415	582	-13	343.3	51.1	715	5.0		
625 *	-301	560	32	346.5	59.1	637	2.3		
645 *	-278	453	134	8.3	56.9	548	4.8		
----	310	1695	847	111.7	71.7	1920	4.6		
----	151	-76	-170	222.6	-24.3	240	30.7		
----	344	-179	-298	214.3	-26.0	489	20.8		

INCLOR: dec = 354.9 inc = 59.1 int = 1949 mad = 4.5



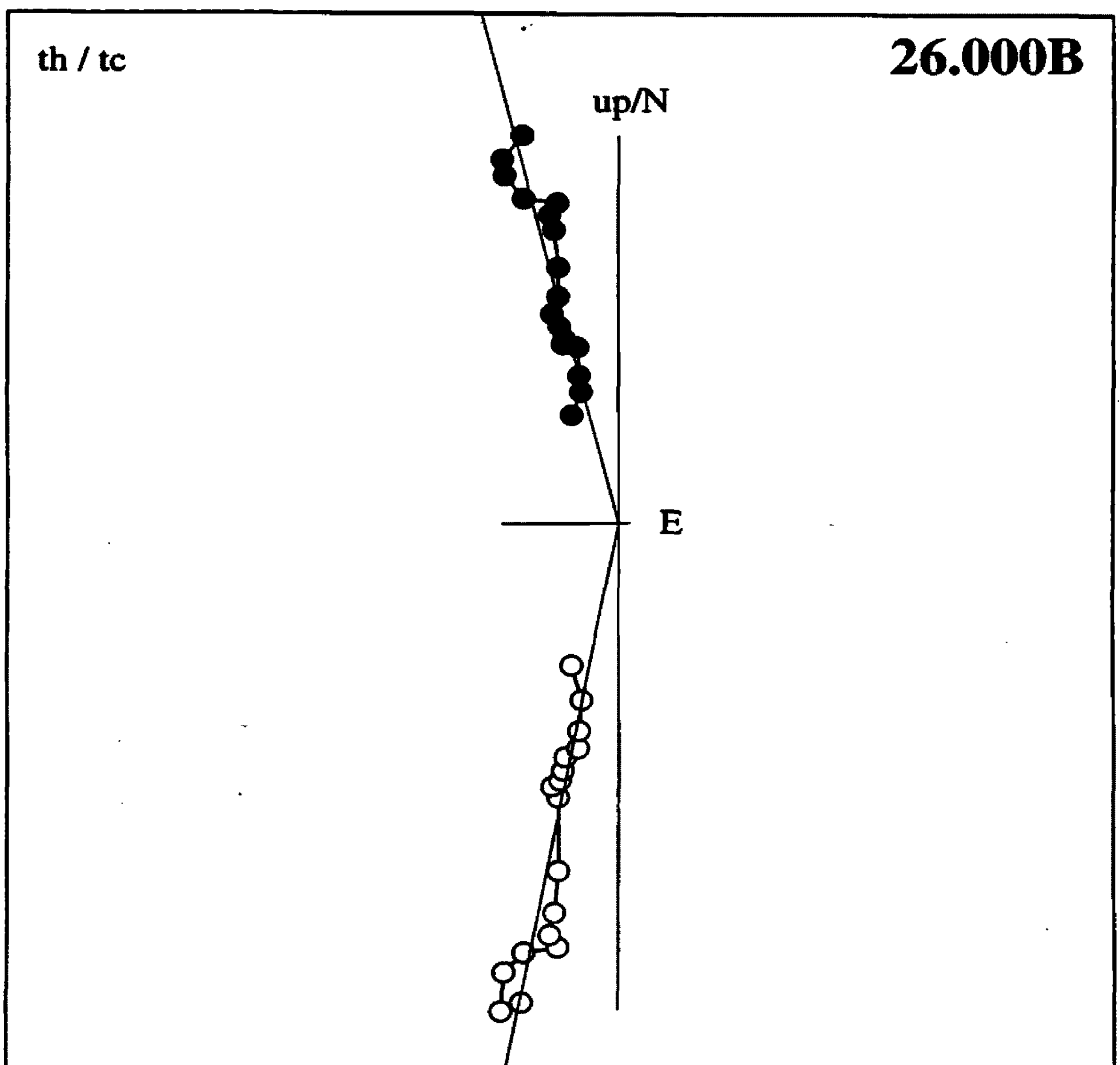
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1393	246	529	2.3	52.9	1510	3.0		
100 *	-1310	295	357	353.6	56.4	1390	2.6		
200 *	-1304	299	377	355.1	56.5	1390	2.8		
300 *	-1323	245	455	359.5	53.7	1420	2.2		
350 *	-1328	269	516	3.4	54.1	1450	3.0		
400 *	-1341	252	490	1.3	53.6	1450	1.9		
450 *	-1249	258	553	7.7	53.5	1390	1.1		
500 *	-1121	186	497	7.0	51.5	1240	2.1		
530 *	-961	122	431	6.7	49.5	1060	0.8		
545 *	-904	134	405	7.0	50.6	1000	2.0		
555 *	-846	173	373	7.5	53.5	941	2.4		
565 *	-812	120	351	5.8	50.8	893	2.2		
575 *	-803	92	319	2.7	49.5	869	3.3		
585 *	-724	76	320	5.8	48.5	795	1.4		
605 *	-642	87	286	6.7	50.0	708	2.4		
625 *	-580	54	280	8.3	47.4	646	1.7		
645 *	-454	94	240	13.8	52.1	522	5.1		
----	-534	-255	271	2.5	19.9	651	33.4		
----	1036	1657	2445	108.2	15.5	3130	11.9		
----	599	-736	-1325	252.9	-43.9	1630	21.0		

INCLOR: dec = 2.9 inc = 53.1 int = 1509 mad = 3.6



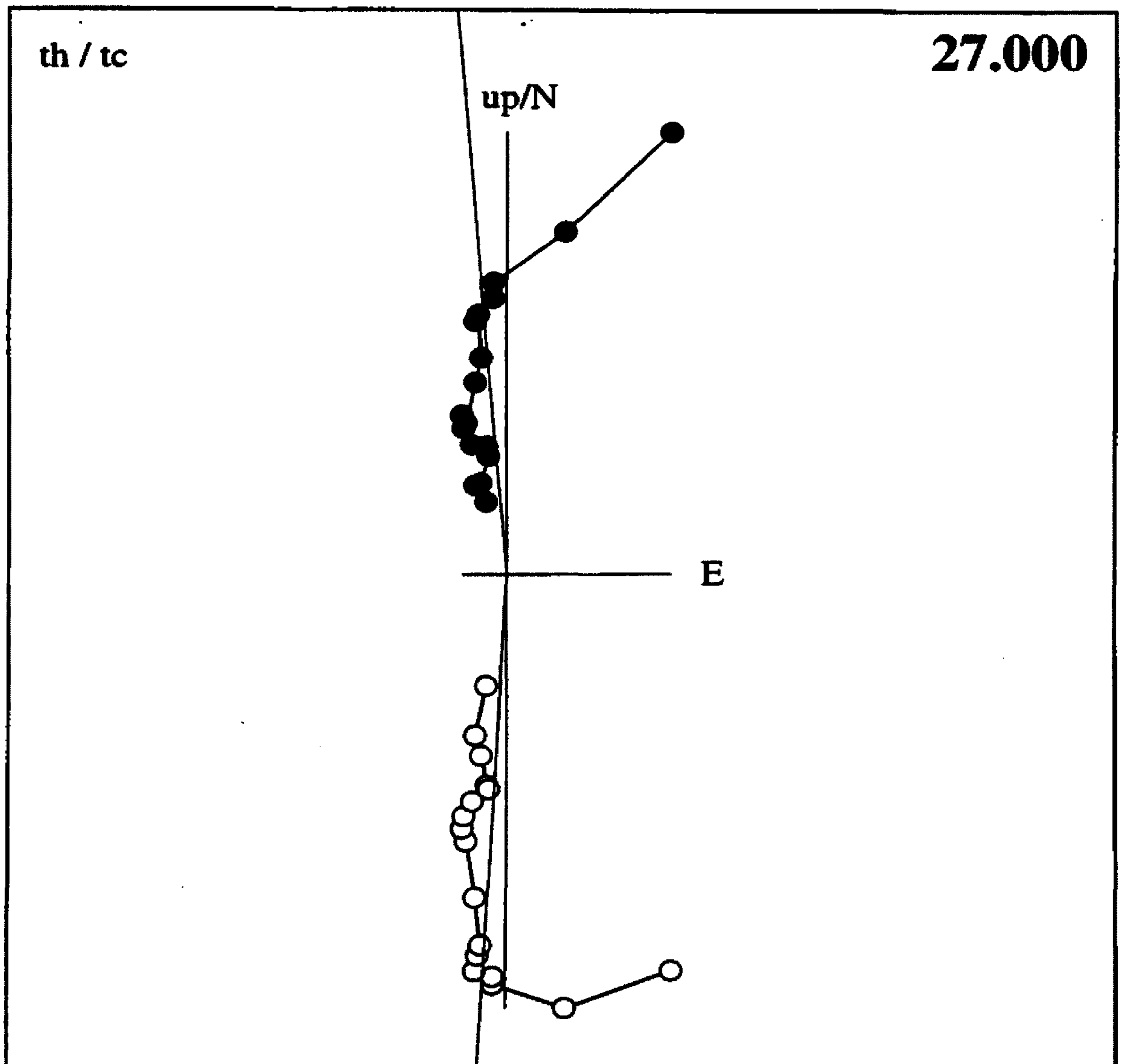
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2280	233	473	347.4	50.0	2340	1.7		
100 *	-2268	309	379	343.8	51.8	2320	2.4		
200 *	-2128	248	344	343.4	50.7	2170	2.0		
300 *	-1999	266	367	345.3	51.7	2050	2.2		
350 *	-1935	280	465	350.3	52.3	2010	2.3		
400 *	-1885	276	418	348.6	52.4	1950	1.7		
450 *	-1788	256	400	348.8	52.2	1850	1.9		
500 *	-1586	243	341	348.0	52.8	1640	2.1		
530 *	-1329	123	262	346.6	49.4	1360	1.9		
545 *	-1265	135	213	344.0	50.2	1290	2.0		
555 *	-1211	155	217	344.9	51.4	1240	2.8		
565 *	-1140	176	197	344.3	52.9	1170	1.9		
575 *	-1114	127	204	345.3	50.7	1140	2.2		
585 *	-1057	133	229	348.2	51.3	1090	2.3		
605 *	-942	159	185	346.4	53.7	973	0.3		
625 *	-822	120	155	345.6	52.4	845	0.9		
645 *	-685	80	74	338.7	50.6	694	5.4		
----	-1316	-382	230	345.6	28.3	1390	16.1		
----	-554	-45	-1063	270.7	9.1	1200	18.4		
----	-195	223	-390	247.6	28.7	490	43.5		

INCLOR: dec = 346.3 inc = 51.5 int = 2340 mad = 1.7



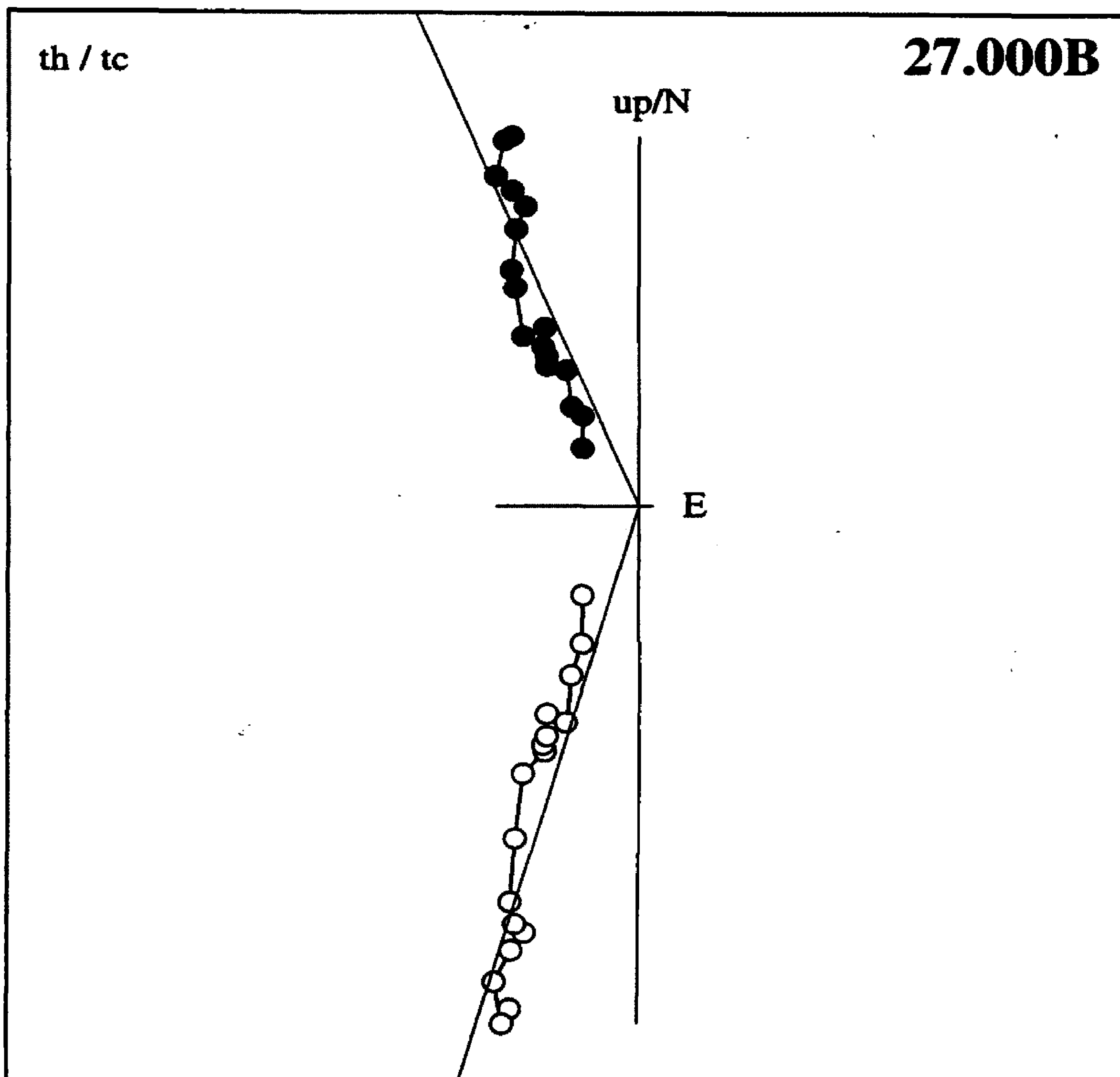
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1976	248	1997	18.7	40.1	2820	1.2		
100 *	-2087	475	1386	8.8	51.0	2550	0.8		
200 *	-2040	427	996	357.7	54.1	2310	1.8		
300 *	-1979	451	948	357.6	55.2	2240	2.1		
350 *	-1943	469	818	353.6	57.0	2160	2.5		
400 *	-1903	406	842	354.5	55.2	2120	1.2		
450 *	-1764	501	721	354.0	59.2	1970	2.3		
500 *	-1565	415	609	351.7	58.7	1730	2.1		
530 *	-1308	340	435	346.5	59.5	1420	2.8		
545 *	-1291	271	437	345.9	56.8	1390	2.9		
555 *	-1217	274	400	345.3	57.8	1310	3.1		
565 *	-1115	288	371	346.5	59.3	1210	2.8		
575 *	-1031	265	407	351.9	58.2	1140	4.3		
585 *	-1016	310	386	352.1	60.8	1130	1.4		
605 *	-860	268	269	345.8	62.3	940	2.9		
625 *	-799	203	232	342.2	59.8	856	3.8		
645 *	-575	112	195	345.7	56.0	617	11.4		
----	-877	-128	22	318.7	38.0	887.	20.4		
----	-307	-120	-145	293.8	19.8	360	48.9		
----	-301	-114	-157	291.4	19.6	358	36.6		

INCLOR: dec = 355.5 inc = 56.4 int = 2550 mad = 4.9



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2337	268	754	342.7	52.1	2470	2.7		
100 *	-2382	306	729	341.5	53.0	2510	1.7		
200 *	-2213	272	604	338.6	53.0	2310	1.4		
300 *	-2070	247	602	340.1	52.7	2170	2.0		
350 *	-1967	256	591	341.1	53.1	2070	2.3		
400 *	-1915	275	507	338.2	54.2	2000	2.8		
450 *	-1783	307	387	334.0	56.1	1850	1.7		
500 *	-1565	186	328	333.0	53.2	1610	1.6		
530 *	-1276	141	204	328.4	52.9	1300	0.9		
545 *	-1195	92	276	334.6	50.8	1230	2.2		
555 *	-1143	119	222	331.5	52.5	1170	2.2		
565 *	-1094	124	205	330.9	53.0	1120	2.3		
575 *	-1012	89	172	329.3	51.6	1030	1.8		
585 *	-995	148	221	334.3	54.8	1030	0.9		
605 *	-783	121	126	328.6	55.3	802	0.8		
625 *	-659	69	121	330.5	52.5	674	3.0		
645 *	-460	22	23	319.0	49.1	461	12.8		
----	-622	-128	34	321.3	34.8	636	17.1		
----	-274	127	-135	262.2	54.4	331	23.0		
----	-143	-136	-141	286.5	-1.5	243	34.0		

INCLOR: dec = 337.7 inc = 53.2 int = 2469 mad = 2.9



Ford Creek 5

Specimens:

28 & 28B & 29 & 29B (avg), 30, 31, 32 & 32B, 33 & 33B, 34 & 35 & 35b, 36, 37

In-situ:

Dec=3.42°, Inc=61.46°

α_{95}=8.96°

k=39.16

δ_{63}=12.14°

Structurally corrected:

Dec=0.10°, Inc=55.84°

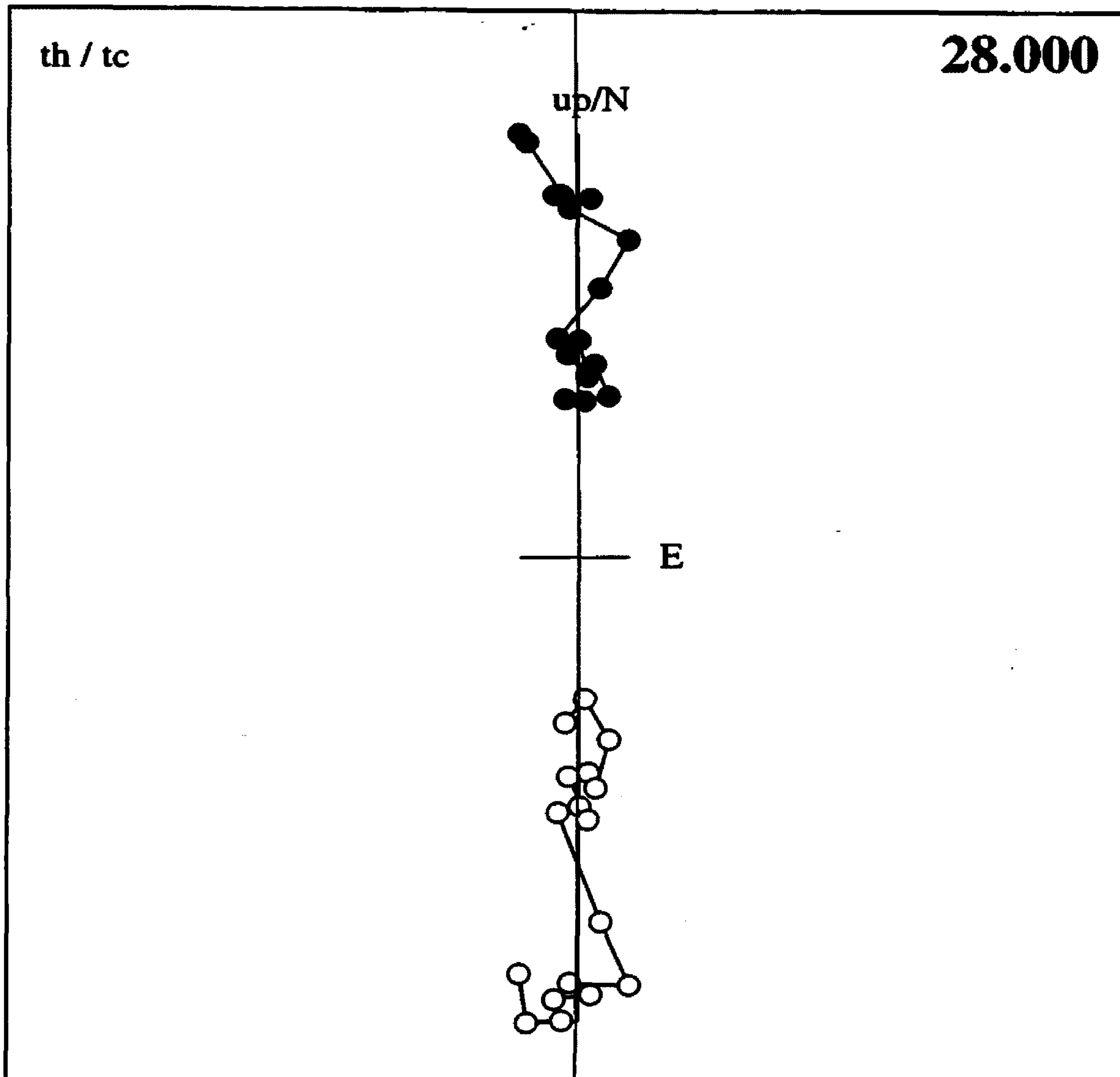
α_{95}=8.94°

k=39.36

δ_{63}=12.10°

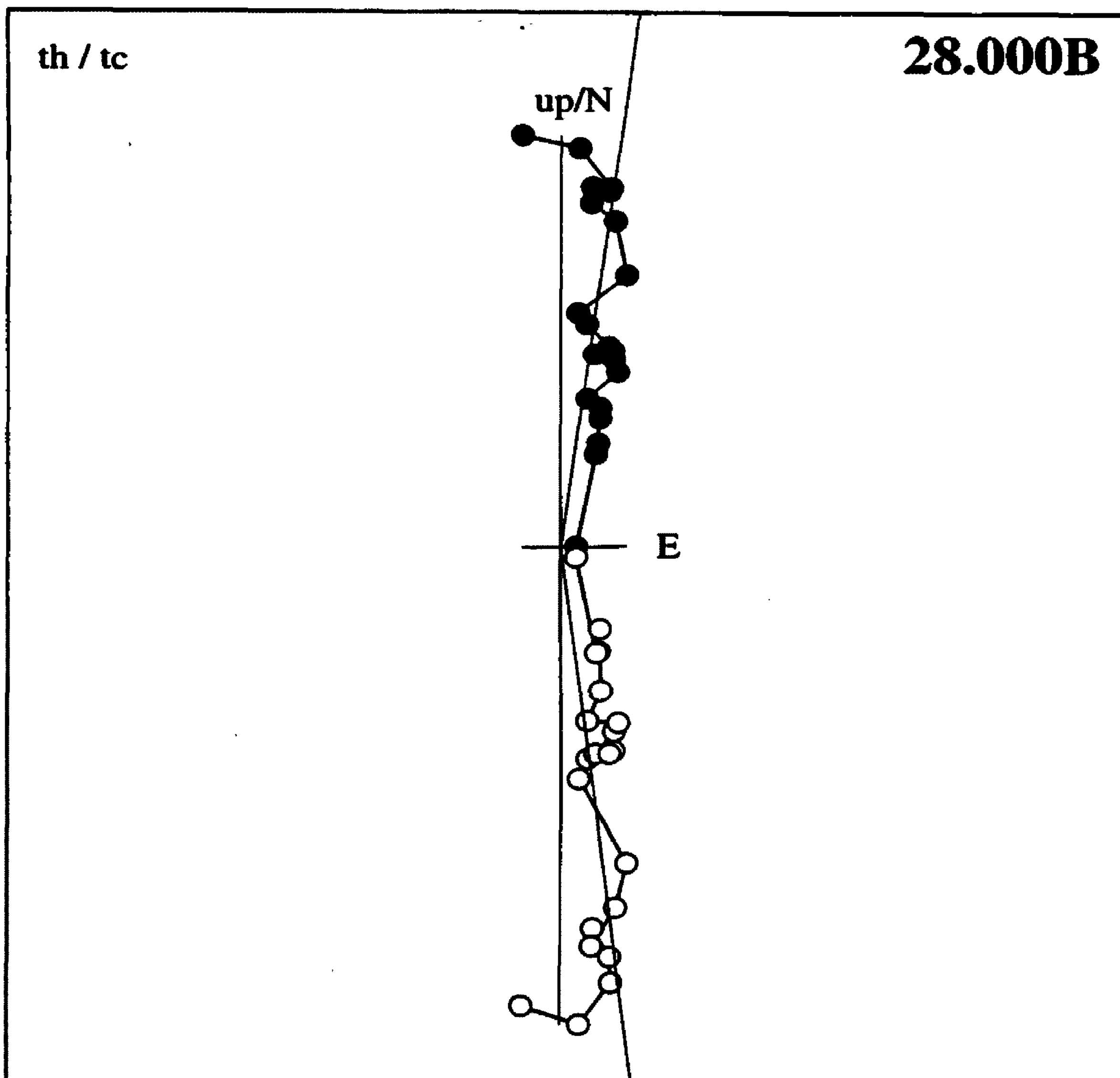
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	370	1778	593	352.8	43.7	1910	2.7		
100 *	280	1902	551	353.6	47.5	2000	1.3		
200 *	184	1830	391	357.7	51.5	1880	2.0		
300 *	209	1769	417	356.6	50.1	1830	1.5		
350 *	247	1765	315	1.8	50.1	1810	1.3		
400 *	216	1709	363	358.6	50.2	1760	1.6		
450 *	195	1691	162	8.3	52.7	1710	1.5		
500 *	141	1430	195	4.2	53.0	1450	1.6		
530 *	136	1036	273	355.0	48.9	1080	4.8		
545 *	165	1025	212	0.2	48.5	1060	4.1		
555 *	58	1008	142	2.6	55.1	1020	4.3		
565 *	163	917	232	357.3	46.8	960	1.6		
575 *	145	886	156	2.6	48.9	911	0.6		
585 *	149	944	145	4.3	49.6	967	1.4		
605 *	156	767	79	9.5	47.9	787	3.4		
625 *	184	636	147	2.0	41.7	678	0.5		
645 *	128	699	196	355.5	46.0	737	2.3		

INCLOR: dec = 359.7 inc = 50.1 int = 2000 mad = 3.6



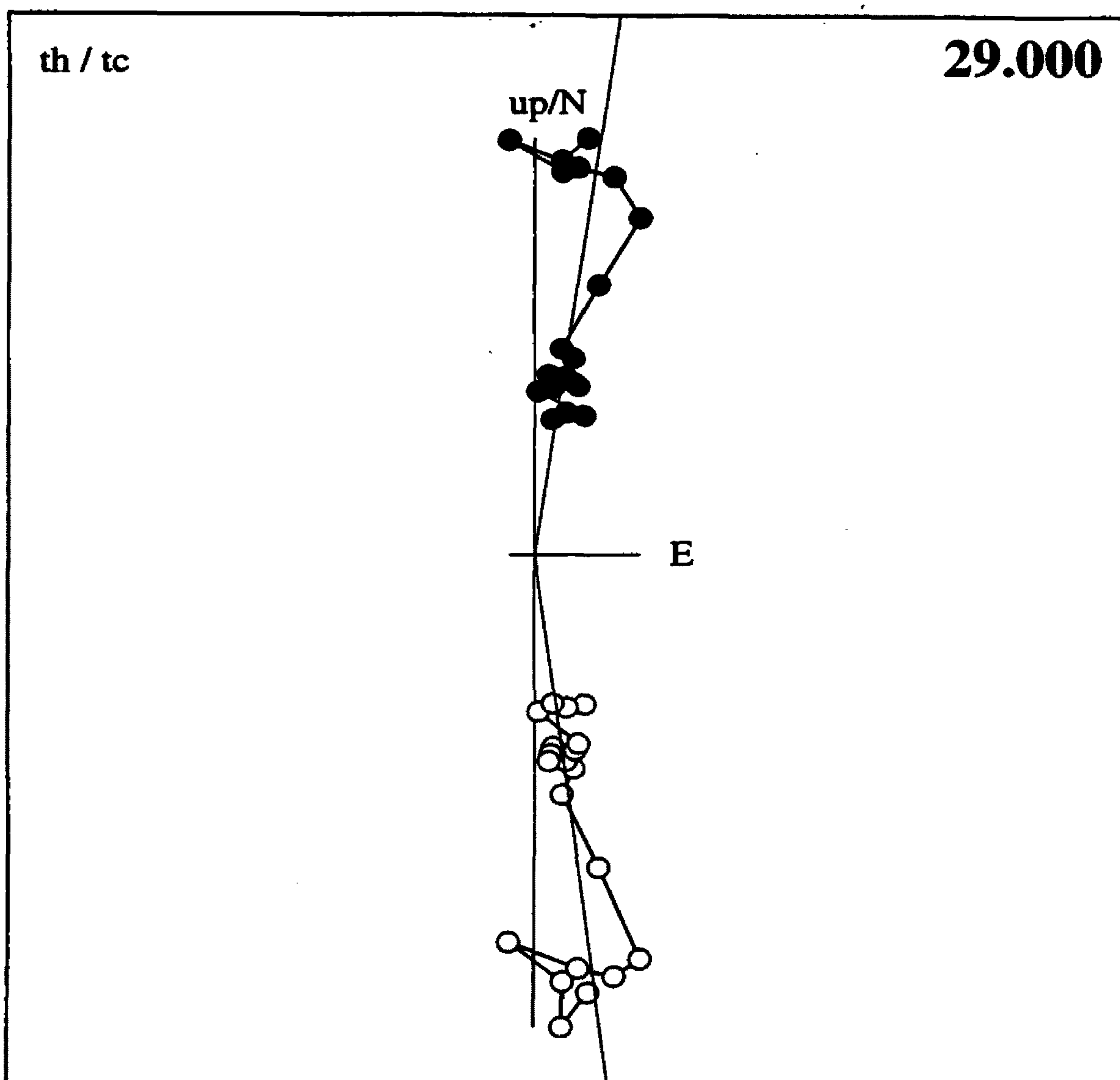
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	374	2454	665	355.1	47.7	2570	1.6		
100 *	372	2526	437	2.5	49.8	2590	1.3		
200 *	368	2315	274	7.3	50.1	2360	1.8		
300 *	406	2216	282	7.1	48.6	2270	1.2		
350 *	457	2112	357	4.6	46.3	2190	1.8		
400 *	365	2144	331	4.6	48.9	2200	1.5		
450 *	415	1984	227	8.7	47.4	2040	1.8		
500 *	345	1722	115	12.4	48.4	1760	1.3		
530 *	328	1317	248	3.9	44.4	1380	1.6		
545 *	342	1227	205	6.1	43.2	1290	2.4		
555 *	305	1158	74	13.6	45.1	1200	2.4		
565 *	265	1153	131	9.2	46.3	1190	2.2		
575 *	318	1072	64	14.3	43.4	1120	2.6		
585 *	309	1177	94	12.3	45.0	1220	4.1		
605 *	299	1017	31	16.5	43.8	1060	2.7		
625 *	172	940	96	9.2	49.0	960	2.8		
645 *	220	822	44	14.4	44.9	852	4.3		
655 *	181	604	3	18.4	43.6	631	4.7		
665 *	311	576	45	15.5	31.6	656	1.9		
675 *	139	587	-6	19.2	47.1	603	4.7		
685 *	-0	48	-57	88.7	38.0	74	21.2		

INCLOR: dec = 7.6 inc = 47.6 int = 2590 mad = 3.8



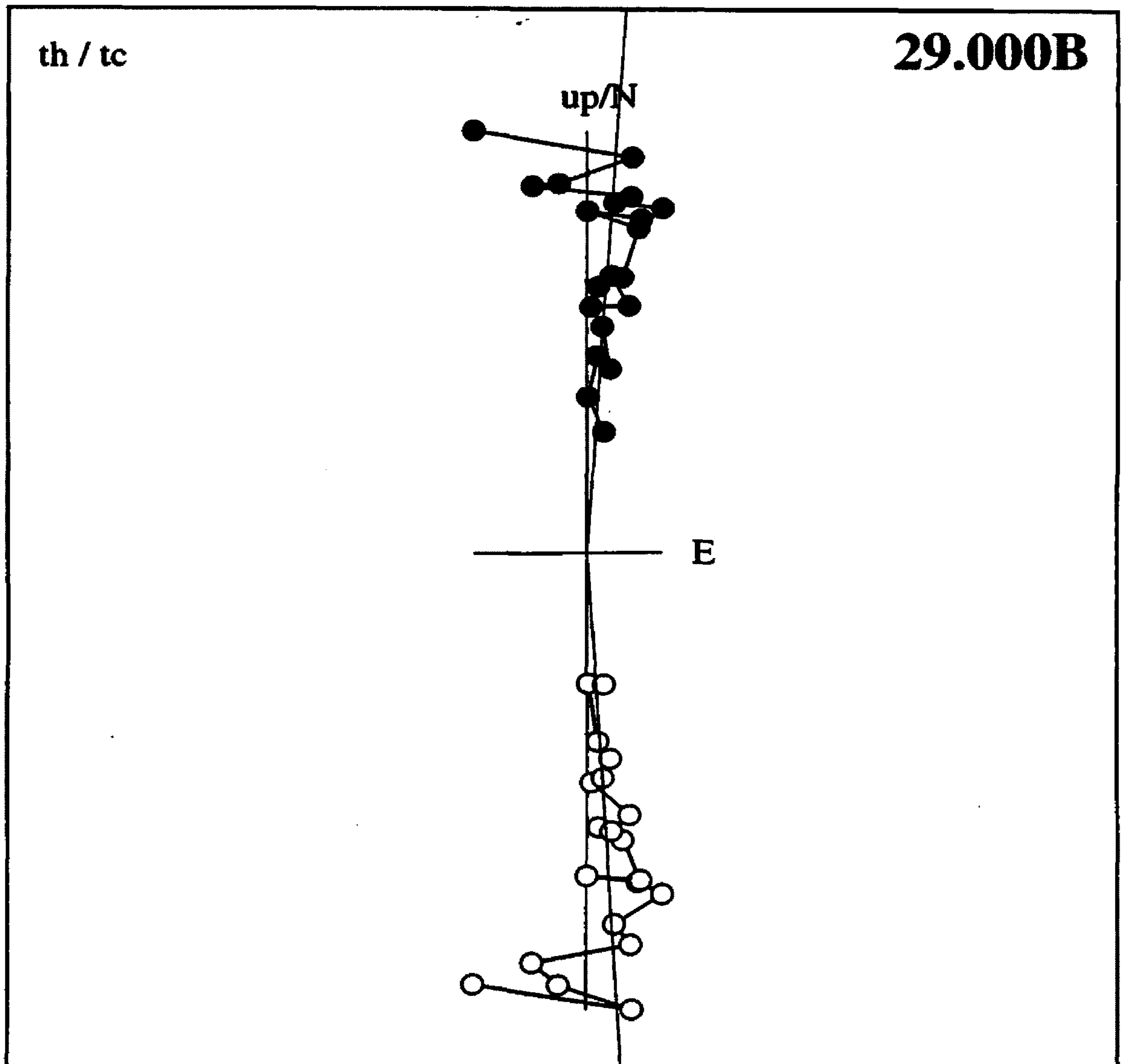
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	566	2157	5	6.7	45.9	2230	2.6		
100 *	418	2220	72	3.6	49.8	2260	1.7		
200 *	462	2058	70	3.8	47.8	2110	1.6		
300	604	1982	274	356.8	42.7	2090	1.4		
350 *	509	2027	25	5.8	46.5	2090	3.0		
400 *	486	2040	-103	10.9	47.3	2100	1.1		
450 *	402	1917	-211	15.9	48.8	1970	1.9		
500 *	331	1501	-99	12.2	48.3	1540	1.5		
530 *	239	1145	-2	6.7	48.8	1170	2.4		
545 *	262	1047	-43	10.1	46.7	1080	3.5		
555 *	211	987	-29	9.1	48.6	1010	1.2		
565 *	194	921	11	5.6	48.7	941	3.8		
575 *	201	955	21	4.7	48.6	976	2.9		
585 *	208	988	30	4.0	48.6	1010	1.7		
605 *	215	942	-60	12.0	47.9	968	2.7		
625 *	220	917	-72	13.1	47.3	946	3.0		
645 *	238	799	64	1.0	43.6	836	1.4		
655 *	202	739	-103	17.8	45.4	773	1.9		
665 *	195	753	-42	11.3	46.3	779	4.8		
675 *	173	725	1	6.6	47.2	745	3.7		
----	5	-14	-50	102.2	-13.6	52	10.7		

INCLOR: dec = 8.2 inc = 48.0 int = 2259 mad = 3.2



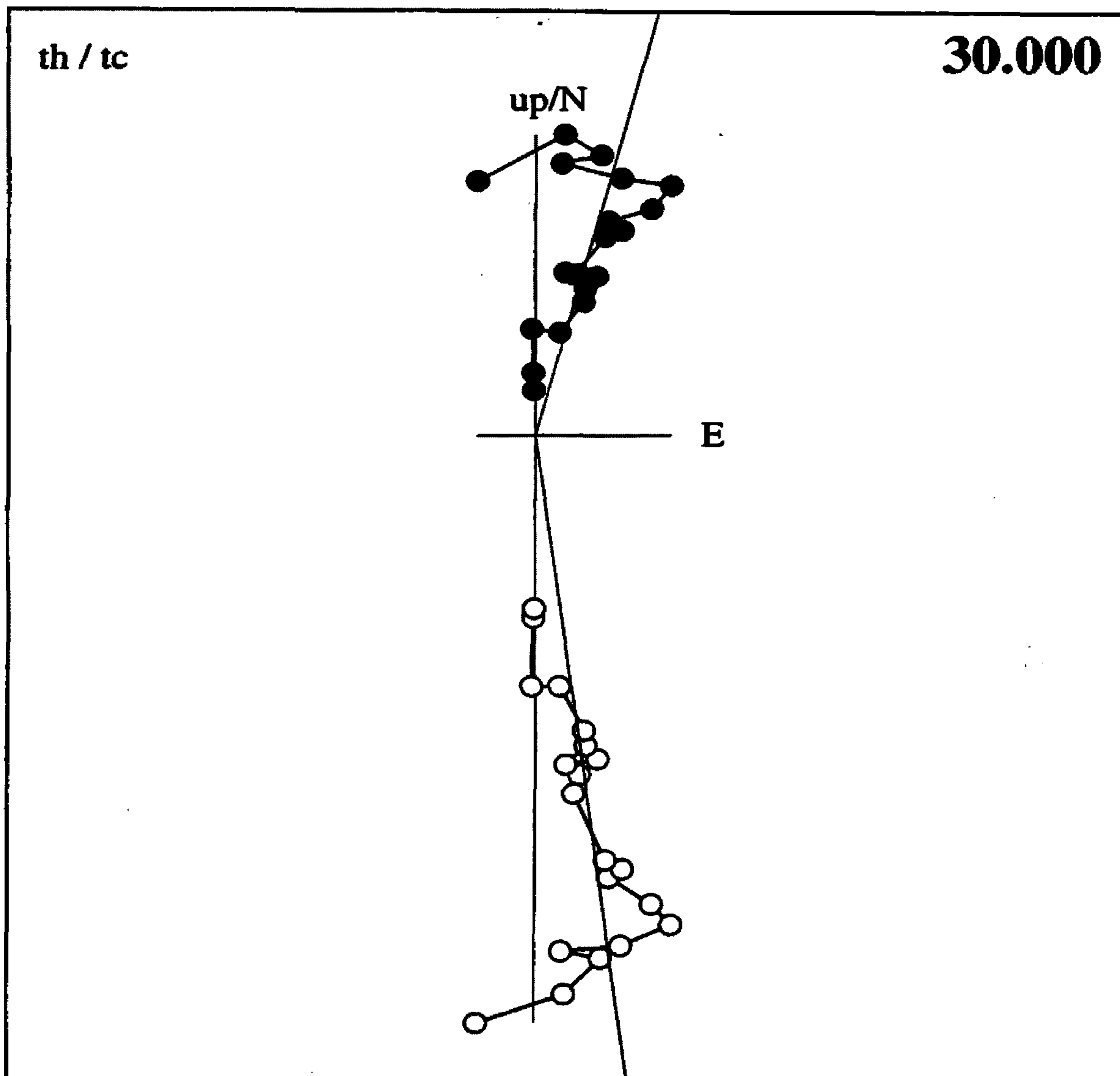
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	479	2026	535	346.4	44.4	2150	1.7		
100 *	443	2083	15	6.0	48.6	2130	1.4		
200 *	366	1952	236	356.1	49.0	2000	1.7		
300 *	382	1875	321	352.4	47.5	1940	1.2		
350 *	433	1819	6	6.5	47.2	1870	2.1		
400 *	440	1744	58	4.1	46.3	1800	2.6		
450 *	500	1654	-91	11.2	43.9	1730	1.5		
500 *	446	1578	-24	8.2	44.9	1640	2.7		
530 *	482	1582	148	0.1	43.1	1660	1.6		
545 *	479	1589	-27	8.3	43.9	1660	1.5		
555 *	360	1363	3	6.7	45.8	1410	1.5		
565 *	342	1304	75	2.3	45.6	1350	0.9		
575 *	375	1338	42	4.5	44.8	1390	0.4		
585 *	322	1238	-32	8.9	46.1	1280	3.8		
605 *	355	1132	94	1.0	42.8	1190	2.0		
625 *	308	1086	48	3.6	44.6	1130	2.5		
645 *	219	954	1	6.6	47.7	979	1.5		
655 *	282	921	53	2.8	43.3	965	5.1		
665 *	250	671	67	0.5	39.6	719	3.0		
675 *	152	615	-2	7.1	46.7	634	2.6		
----	51	8	-21	34.3	-17.7	56	29.5		

INCLOR: dec = 3.7 inc = 46.1 int = 2130 mad = 4.1



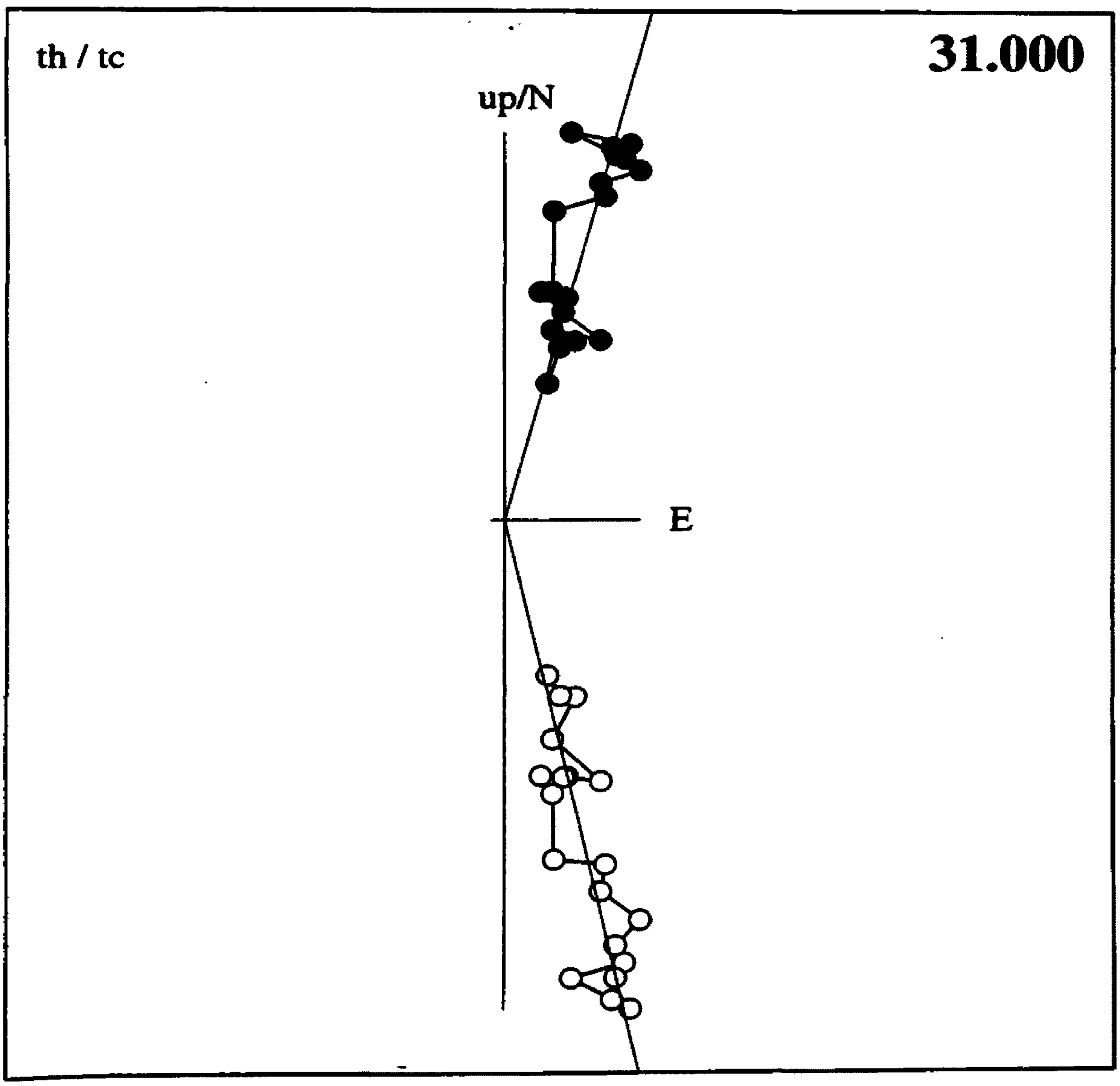
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1318	1513	-109	348.4	65.8	2010	3.1		
100 *	-1216	1526	-394	5.1	61.3	1990	1.1		
200 *	-1156	1392	-470	12.0	61.0	1870	1.8		
300 *	-1130	1395	-356	5.0	61.8	1830	0.9		
350 *	-1158	1297	-501	16.8	61.9	1810	1.1		
400 *	-1132	1208	-627	26.1	60.1	1770	4.1		
450 *	-1095	1134	-550	24.8	61.7	1670	3.8		
500 *	-1018	1104	-422	17.2	62.8	1560	2.9		
530 *	-1012	1056	-449	21.0	62.9	1530	3.3		
545 *	-987	1043	-397	17.6	63.6	1490	3.4		
555 *	-833	878	-271	12.1	65.1	1240	2.5		
565 *	-780	852	-287	13.6	63.6	1190	4.2		
575 *	-746	808	-334	19.4	62.2	1150	3.3		
585 *	-743	854	-253	9.5	63.0	1160	2.3		
605 *	-718	767	-290	17.2	63.3	1090	2.1		
625 *	-691	714	-270	17.9	64.2	1030	2.6		
645 *	-595	592	-173	12.1	67.0	857	3.1		
655 *	-579	626	-102	358.3	66.7	859	4.5		
665 *	-441	415	-60	358.4	70.8	608	7.2		
675 *	-437	354	-43	358.7	75.3	564	9.9		
----	-389	1273	364	320.4	40.3	1380	13.7		

INCLOR: dec = 14.7 inc = 62.8 int = 1989 mad = 3.9



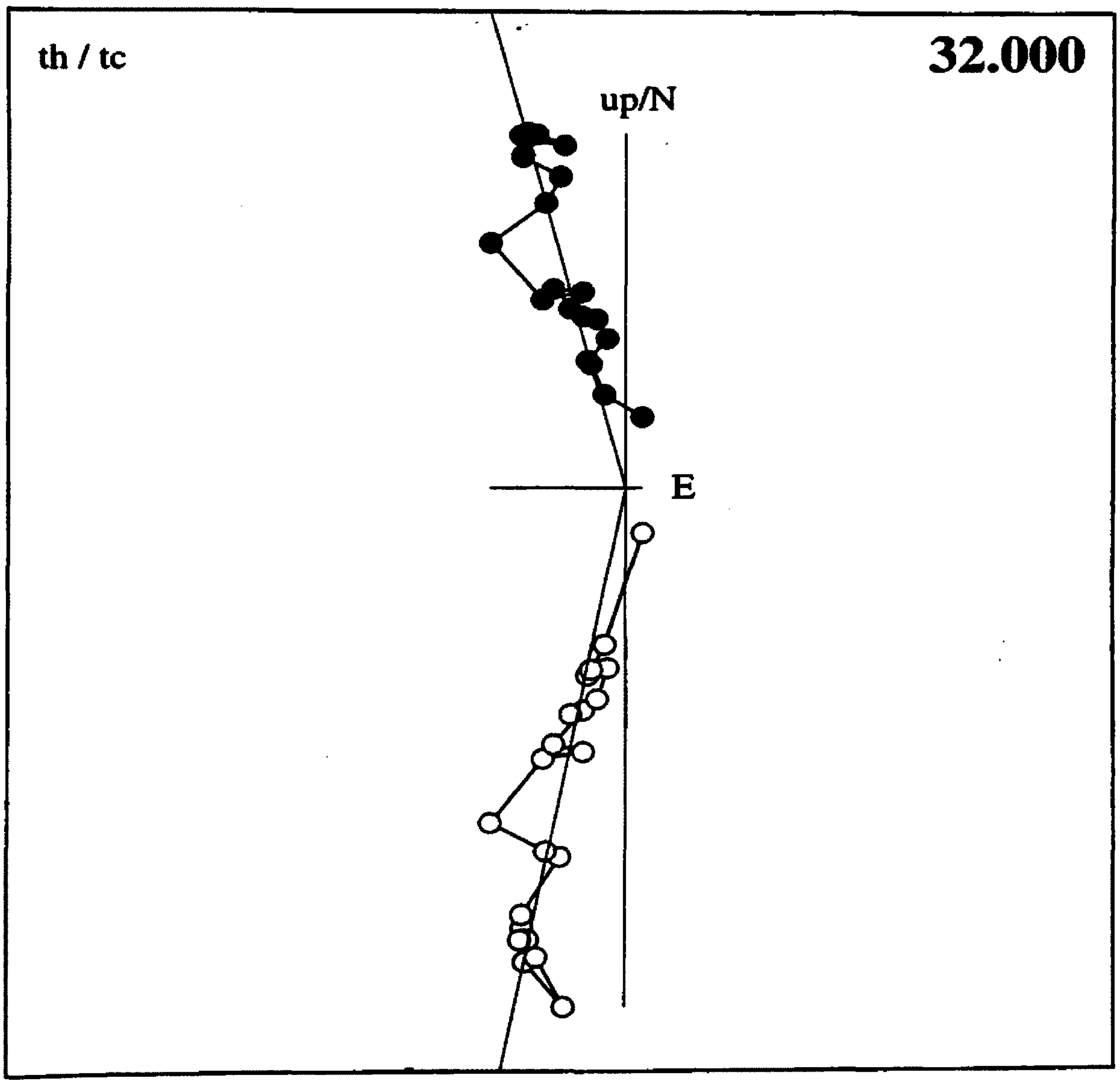
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	731	1909	154	14.7	50.9	2050	2.2		
100 *	758	1945	107	16.9	50.8	2090	2.1		
200 *	739	1846	294	8.9	49.0	2010	3.3		
300 *	753	1785	113	16.7	49.2	1940	2.9		
350 *	749	1838	146	15.2	49.7	1990	1.9		
400 *	767	1732	146	15.5	48.0	1900	2.6		
450 *	782	1642	63	19.4	46.9	1820	2.0		
500 *	720	1532	158	14.5	46.5	1700	1.7		
530 *	715	1436	132	15.7	45.4	1610	1.8		
545 *	608	1393	250	8.3	47.1	1540	1.6		
555 *	443	1105	150	10.7	49.3	1200	2.9		
565 *	462	1048	105	14.2	47.9	1150	2.0		
575 *	444	1045	184	8.2	47.7	1150	2.9		
585 *	417	1035	92	14.4	49.9	1120	3.7		
605 *	385	1029	-51	25.7	52.3	1100	2.8		
625 *	389	896	104	12.8	48.1	982	3.5		
645 *	429	755	36	19.7	42.7	869	1.4		
655 *	391	742	68	16.2	44.1	842	3.5		
665 *	292	638	53	15.8	47.3	704	12.8		
----	211	666	-216	50.3	53.5	731	13.0		
----	-476	850	-443	145.4	66.7	1070	14.9		

INCLOR: dec = 14.7 inc = 48.6 int = 2050 mad = 3



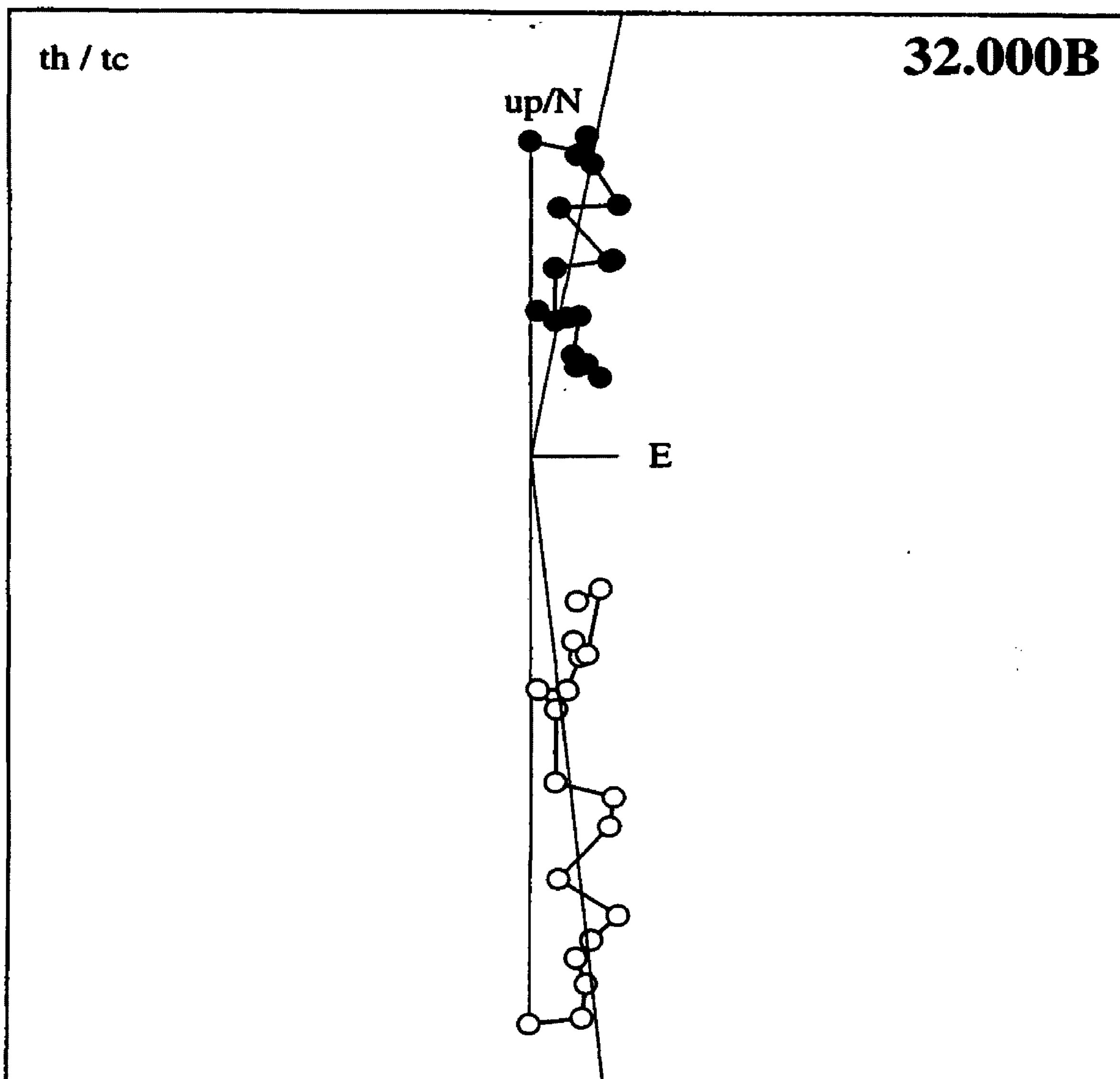
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	*	-1877	1470	847	345.4	52.6	2530	2.9		
100	*	-2046	1537	687	350.8	56.1	2650	0.9		
200	*	-1848	1505	818	347.2	52.1	2520	1.4		
300	*	-1745	1385	838	344.4	51.7	2380	1.8		
350	*	-1778	1485	857	346.1	50.8	2470	1.0		
400	*	-1786	1463	878	344.9	50.9	2470	0.8		
450	*	-1690	1367	839	344.3	51.0	2330	0.9		
500	*	-1440	1317	689	349.3	49.3	2070	1.6		
530	*	-1436	1190	694	345.7	50.9	1990	1.0		
545	*	-1360	928	821	333.4	50.6	1840	1.0		
555	*	-1093	757	552	338.3	53.1	1440	3.4		
565	*	-1041	848	431	348.9	52.7	1410	4.4		
575	*	-1023	806	540	341.8	50.7	1410	2.3		
585	*	-879	730	398	347.4	51.5	1210	3.4		
605	*	-899	740	455	344.3	50.5	1250	3.1		
625	*	-826	736	349	351.3	50.9	1160	3.6		
645	*	-698	657	285	353.8	50.0	1000	5.0		
655	*	-750	545	311	344.9	54.8	978	4.4		
665	*	-726	535	293	346.0	54.8	948	7.8		
675	*	-629	423	197	348.5	58.7	783	11.4		
685		-151	327	59	12.1	32.1	365	20.1		

INCLOR: dec = 345.7 inc = 52.0 int = 2530 mad = 3



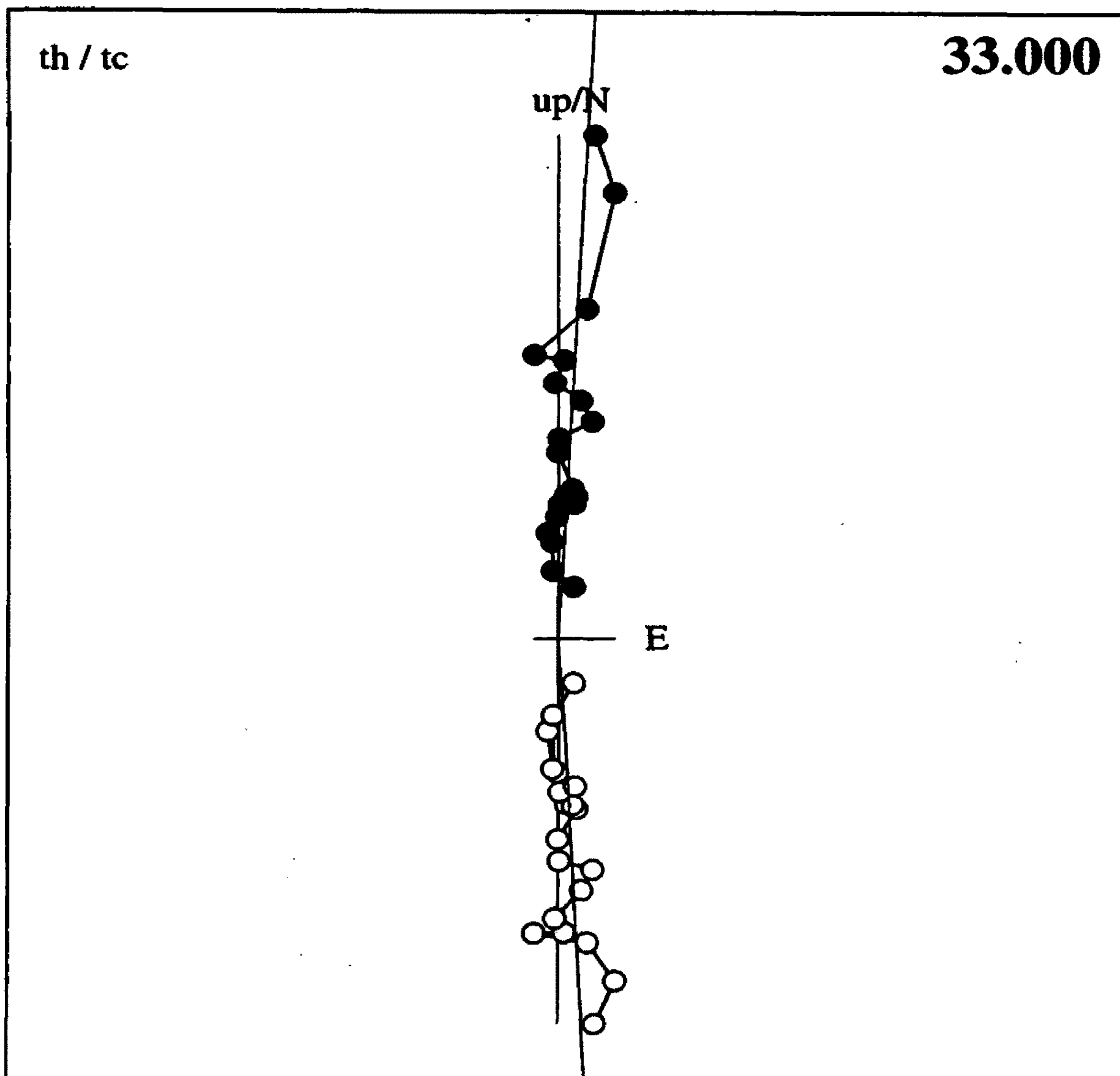
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 •	-1789	1255	331	359.9	60.8	2210	3.5		
100 •	-1752	1287	169	8.8	61.1	2180	2.0		
200 •	-1632	1323	189	9.1	58.3	2110	0.3		
300 •	-1557	1240	196	7.9	58.6	2000	1.1		
350 •	-1498	1225	145	10.8	58.3	1940	2.2		
400 •	-1420	1122	16	17.5	60.0	1810	2.9		
450 •	-1324	1017	187	5.9	59.3	1680	2.7		
500 •	-1144	890	-20	20.1	60.6	1450	4.0		
530 •	-1045	886	-22	20.8	58.3	1370	1.9		
545 •	-1020	778	134	6.6	59.7	1290	1.7		
555 •	-792	578	71	9.3	61.3	983	2.5		
565 •	-730	576	140	2.4	57.9	940	2.6		
575 •	-723	595	47	13.5	58.4	937	2.8		
585 •	-606	599	23	17.5	53.6	852	2.5		
605 •	-569	462	-14	20.8	59.5	733	5.4		
625 •	-613	460	-67	28.7	61.8	769	3.1		
645 •	-391	402	-109	38.6	52.6	572	3.9		
655 •	-439	411	-31	25.0	55.7	602	4.8		
----	-333	254	-235	71.8	53.0	481	14.4		
----	-286	331	-284	68.2	42.5	521	15.1		
----	-96	176	-316	88.4	22.7	374	16.6		

INCLOR: dec = 10.5 inc = 59.6 int = 2209 mad = 3.9



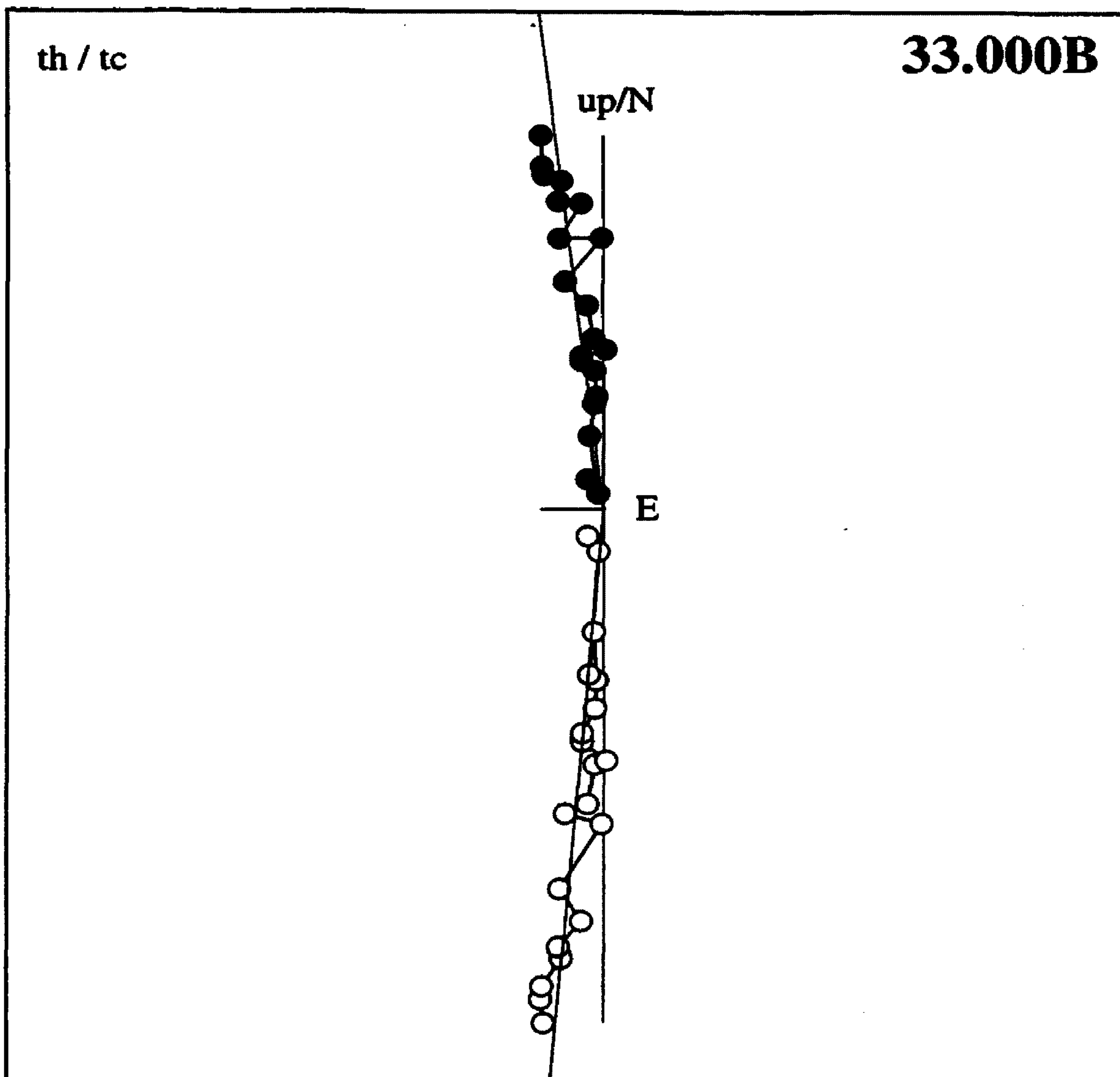
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2143	2531	-2642	3.8	37.0	4240	1.8		
100 *	-1936	2133	-2432	6.6	36.9	3770	1.2		
200 *	-1740	1724	-1732	4.5	42.1	3000	1.8		
300 *	-1640	1759	-1291	355.6	45.6	2730	1.2		
350 *	-1684	1600	-1376	1.1	46.2	2700	1.8		
400 *	-1600	1527	-1228	359.3	47.2	2530	2.8		
450 *	-1476	1288	-1244	5.0	46.2	2320	2.5		
500 *	-1373	1116	-1186	8.2	46.2	2130	2.3		
530 *	-1285	1188	-969	0.1	47.8	2000	1.5		
545 *	-1153	1098	-901	359.9	46.9	1830	1.0		
555 *	-1018	786	-752	6.5	49.7	1490	1.7		
565 *	-967	827	-717	2.7	48.8	1460	2.4		
575 *	-984	825	-776	4.9	47.8	1500	3.0		
585 *	-888	800	-649	0.3	48.6	1360	3.8		
605 *	-876	723	-711	6.2	47.4	1340	1.8		
625 *	-769	730	-583	359.2	47.5	1210	1.5		
645 *	-502	635	-477	354.6	41.0	940	2.3		
655 *	-757	638	-431	356.6	53.3	1080	2.9		
665 *	-436	433	-303	355.3	48.4	685	12.6		
675 *	-270	215	-311	15.0	39.7	464	20.9		
----	79	120	-46	325.9	-19.0	151	55.8		

INCLOR: dec = 3.0 inc = 43.1 int = 4240 mad = 5.4



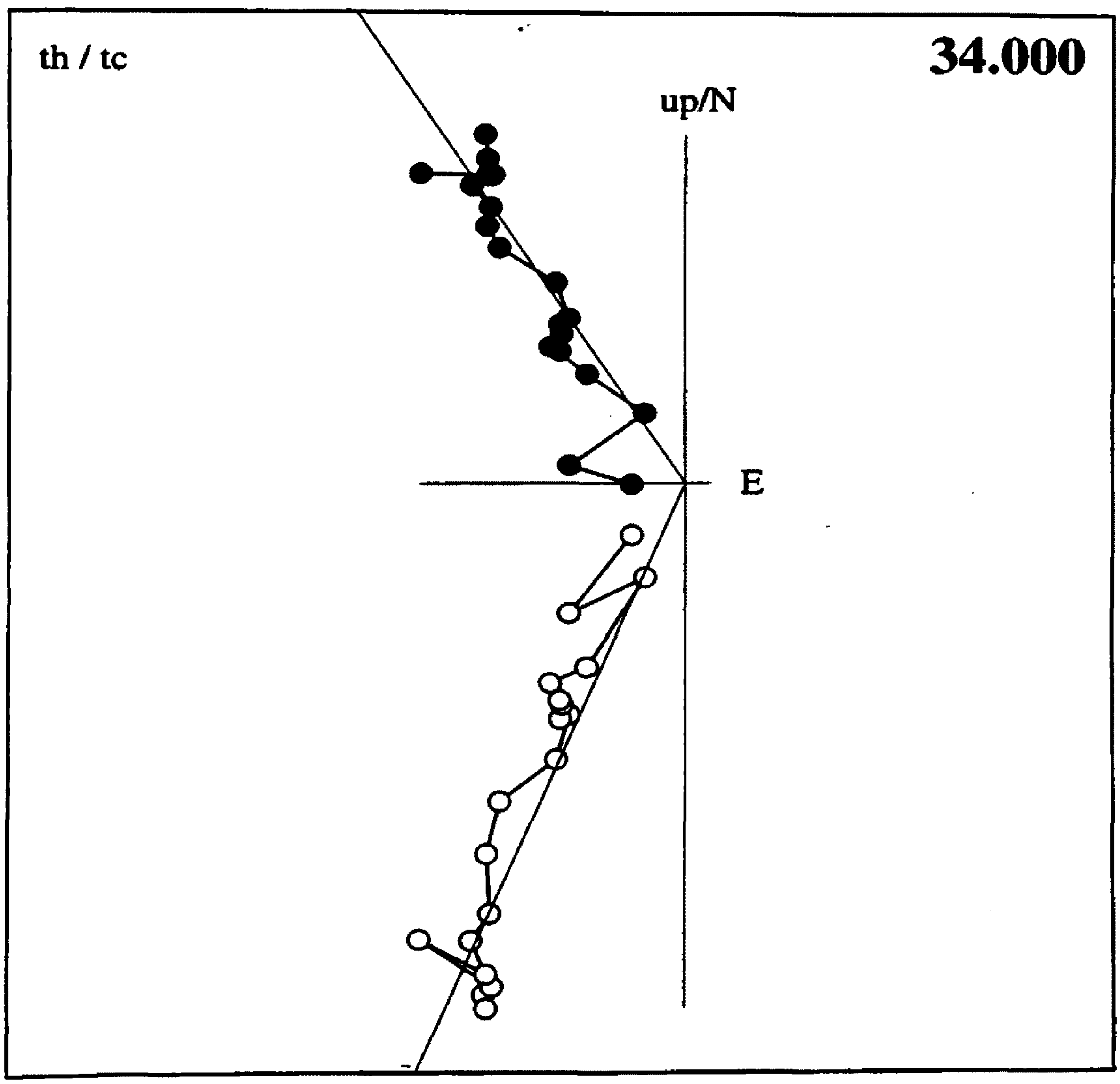
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	*	-2335	1967	-1056	350.8	56.3	3230	3.4		
100	*	-2187	2072	-1219	351.4	52.0	3250	1.7		
200	*	-2142	1953	-1099	350.8	53.6	3100	1.7		
300	*	-2033	1799	-1103	353.4	53.3	2930	1.6		
350	*	-1983	1731	-1012	352.4	54.3	2820	0.9		
400	*	-1881	1608	-1081	356.2	53.0	2700	2.0		
450	*	-1713	1532	-878	351.5	53.9	2460	1.4		
500	*	-1437	1296	-1025	359.6	49.0	2190	1.5		
530	*	-1367	1273	-741	351.4	52.6	2010	1.5		
545	*	-1359	1104	-711	356.0	55.0	1890	3.2		
555	*	-1188	922	-602	357.1	56.0	1620	1.8		
565	*	-1187	838	-594	0.8	57.4	1570	4.4		
575	*	-1067	878	-501	352.7	56.2	1470	2.5		
585	*	-1027	854	-484	352.3	56.0	1420	2.6		
605	*	-921	743	-488	356.6	54.9	1280	4.8		
625	*	-796	614	-394	356.7	56.4	1080	3.0		
645	*	-551	536	-371	355.2	49.1	854	3.2		
655	*	-781	505	-210	349.9	65.7	953	4.4		
665	*	-201	125	-34	341.7	69.1	239	29.6		
675	*	-101	189	-70	334.6	38.7	226	35.8		

INCLOR: dec = 353.3 inc = 54.0 int = 3230 mad = 2.8



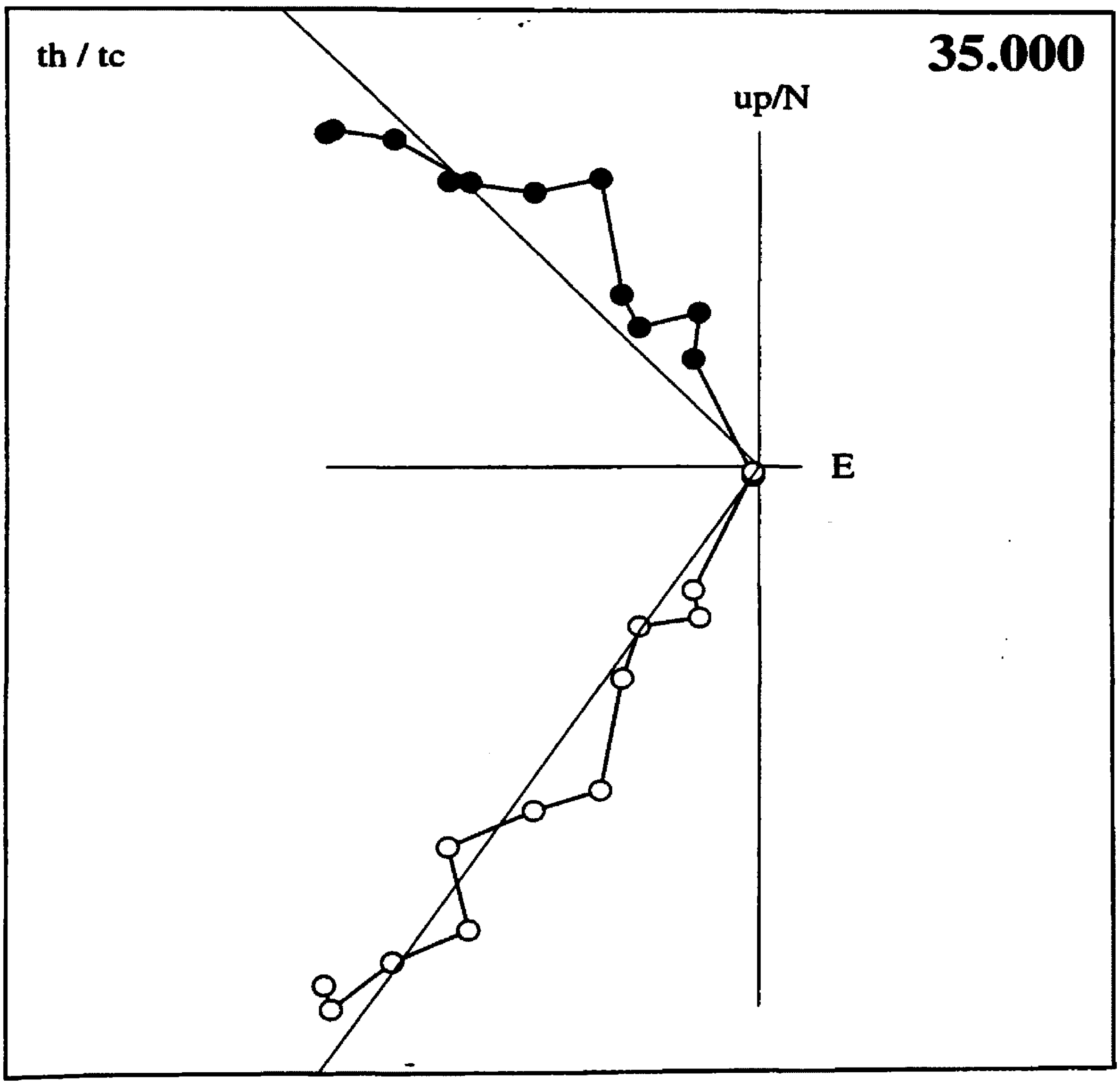
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	162	2180	864	332.6	52.1	2350	0.9		
100 *	66	2187	830	331.2	54.4	2340	1.3		
200 *	51	2091	801	330.6	54.5	2240	0.7		
300	68	1924	1043	322.4	49.0	2190	2.2		
350 *	66	2051	822	330.0	53.7	2210	1.3		
400 *	72	1922	867	327.2	51.8	2110	1.6		
450 *	61	1802	794	327.6	52.3	1970	1.1		
500 *	88	1577	799	325.3	49.4	1770	0.5		
530 *	110	1375	751	324.7	47.3	1570	2.6		
545 *	111	1197	546	329.9	49.6	1320	3.7		
555 *	76	998	480	327.7	49.4	1110	2.3		
565 *	42	1000	503	324.7	50.0	1120	1.3		
575 *	36	939	490	323.5	49.6	1060	3.2		
585 *	-16	898	483	319.5	50.9	1020	4.7		
605 *	17	845	520	318.4	47.2	992	2.0		
625 *	-15	756	381	321.0	52.2	847	5.3		
645 *	46	413	175	332.8	49.7	451	8.9		
655 *	-240	433	360	279.8	50.5	612	8.6		
665 *	-128	159	161	268.9	46.7	260	25.9		
----	-242	-25	77	214.3	17.1	255	17.0		

INCLOR: dec = 327.9 inc = 52.0 int = 2350 mad = 4.2



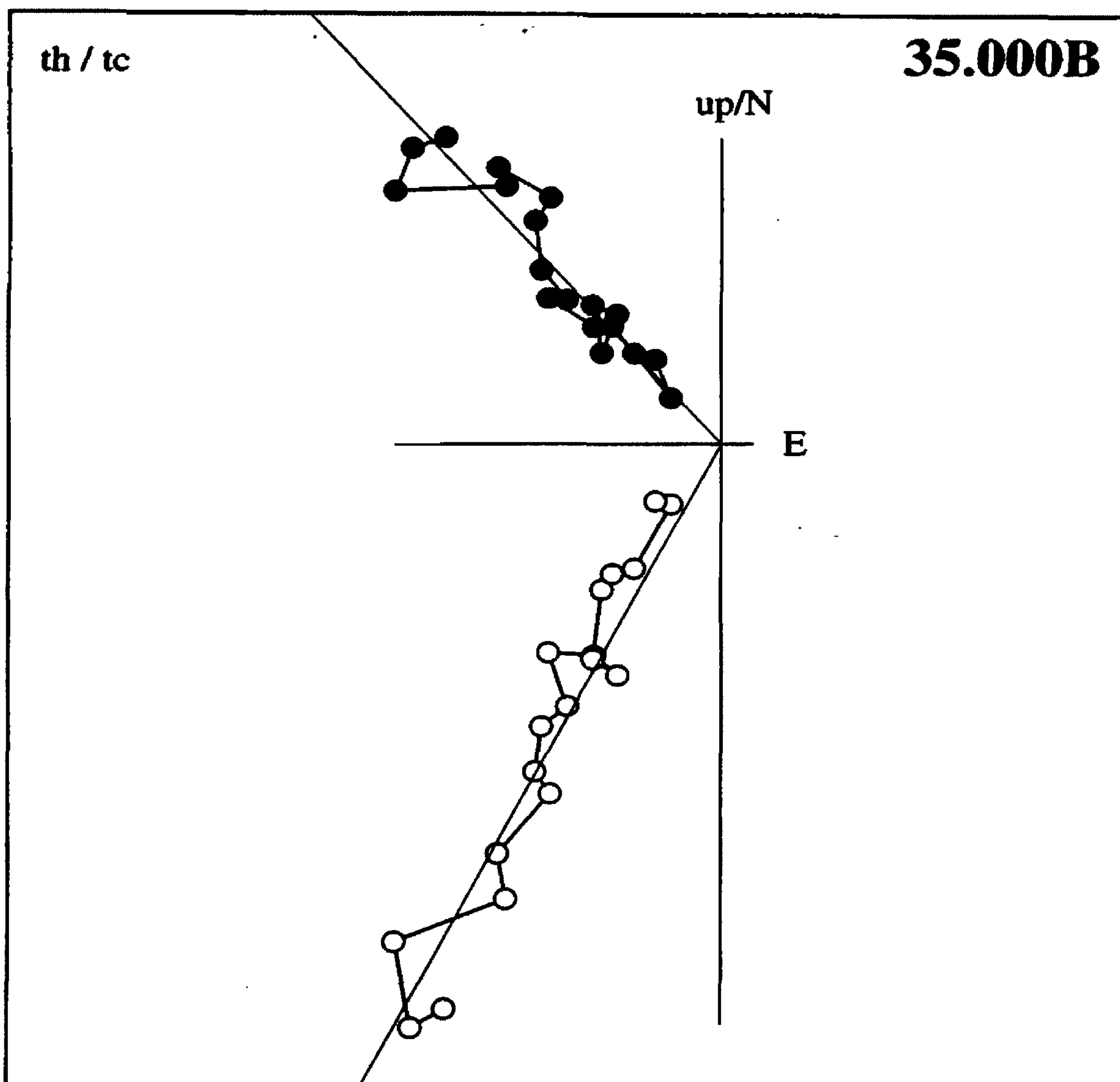
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-30	1289	663	310.4	44.9	1450	1.4		
100 *	-55	1329	648	311.1	46.3	1480	0.8		
200 *	-23	1235	546	314.7	46.4	1350	2.8		
300 *	-66	1121	424	317.3	49.8	1200	1.4		
350 *	40	997	464	315.4	43.2	1100	2.9		
400 *	51	913	315	323.3	45.0	967	2.8		
450 *	84	886	193	333.4	45.0	911	3.5		
500 *	35	568	191	324.1	44.8	600	3.8		
530 *	44	443	171	322.0	42.0	477	3.1		
545 *	67	437	59	340.7	42.7	446	3.8		
555 *	29	339	83	331.1	45.0	350	4.3		
675 *	-20	-2	12	208.0	26.5	24	13.9		

INCLOR: dec = 316.7 inc = 46.0 int = 1449 mad = 5.4



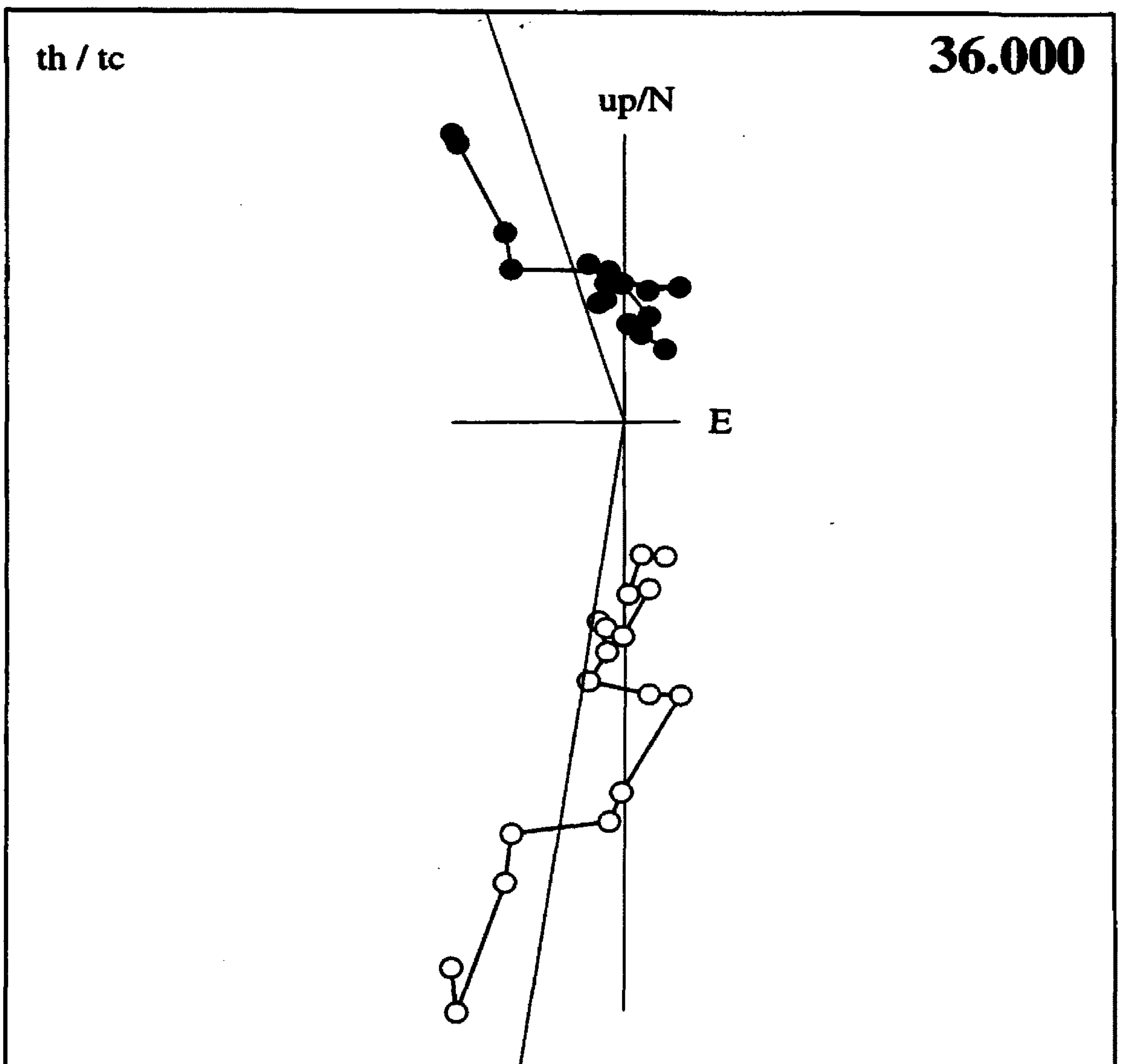
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-102	850	253	320.9	54.7	893	5.1		
100 *	-124	864	293	316.6	54.8	921	3.7		
200 *	-98	746	323	310.6	51.7	819	3.3		
300 *	-73	695	194	322.9	54.4	725	5.3		
350 *	-18	665	201	323.8	49.9	695	3.4		
400 *	-7	575	146	328.0	50.1	593	4.4		
450 *	-11	536	169	323.0	49.4	562	4.6		
500 *	-26	449	172	316.9	49.6	482	4.4		
530 *	-43	402	148	316.0	52.4	430	6.0		
545 *	3	350	170	313.1	44.1	389	2.9		
555 *	-35	325	122	315.5	52.1	349	3.7		
565 *	-40	353	92	324.1	55.1	367	2.7		
575 *	-15	347	120	320.1	49.8	367	4.1		
585 *	-9	236	119	310.3	45.8	265	4.7		
605 *	29	240	103	320.2	40.2	263	6.2		
625 *	3	211	82	319.1	46.0	226	7.9		
645 *	5	105	49	315.4	43.0	116	7.6		
655 *	48	134	61	324.6	28.9	155	2.6		
----	-12	73	-16	15.3	59.7	76	4.0		

INCLOR: dec = 319.1 inc = 52.0 int = 893 mad = 4.6



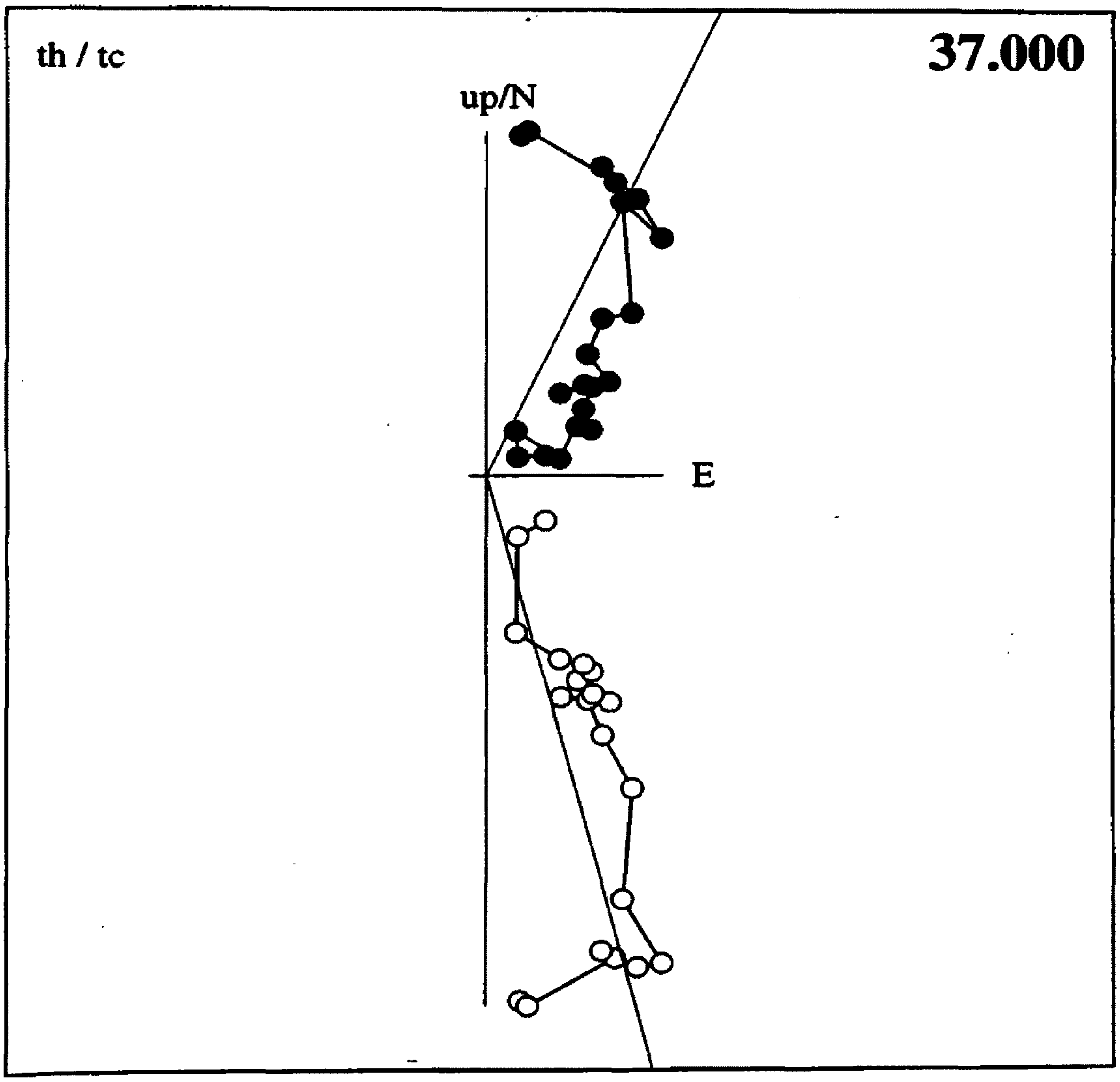
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-210	1083	418	331.6	58.7	1180	4.1		
100 *	-262	1146	395	331.6	61.5	1240	0.3		
200 *	-238	874	270	330.3	64.5	945	3.5		
300 *	-242	766	238	326.1	65.8	838	4.6		
350 *	-169	773	90	354.5	69.1	796	4.1		
400 *	-151	719	66	358.6	69.3	738	2.1		
450 *	-28	576	-16	20.5	62.3	577	2.2		
500 *	-51	562	30	9.3	63.8	565	1.8		
530 *	-40	549	145	348.4	57.8	569	3.5		
545 *	-28	490	107	353.3	58.4	502	2.9		
555 *	-33	421	106	349.1	58.6	435	1.7		
565 *	-30	437	97	352.3	58.9	449	1.0		
575 *	-4	469	83	359.3	57.0	476	4.2		
585 *	10	372	22	12.0	57.2	373	3.4		
605 *	-18	367	48	2.1	60.1	371	4.3		
625 *	13	300	26	9.8	55.9	301	2.5		
645 *	4	294	-24	27.0	58.9	295	11.9		
----	-46	27	24	250.5	50.0	59	11.8		

INCLOR: dec = 343.1 inc = 63.2 int = 1180 mad = 8.4



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1183	1103	328	5.2	56.8	1650	2.9		
100 *	-1191	1126	319	6.3	56.6	1670	3.1		
200 *	-1048	1098	81	21.7	56.6	1520	4.0		
300 *	-1030	1110	132	18.7	55.4	1520	3.0		
350 *	-1065	1099	10	26.4	57.6	1530	2.1		
400 *	-1059	1044	-95	33.8	59.4	1490	2.2		
450 *	-903	1029	50	24.3	54.5	1370	3.2		
500 *	-662	735	-110	39.0	56.0	995	5.4		
530 *	-545	651	-49	33.7	53.9	850	4.1		
545 *	-477	531	-65	36.9	55.9	717	3.9		
555 *	-481	503	-150	49.7	57.2	712	3.7		
565 *	-496	412	-70	39.1	64.3	649	3.5		
575 *	-423	445	-100	44.3	57.3	622	1.4		
585 *	-472	464	-125	47.5	59.1	674	1.9		
605 *	-460	352	-150	59.1	64.8	598	1.8		
625 *	-433	358	-181	64.2	61.7	590	2.8		
645 *	-409	387	-133	52.9	59.6	579	6.7		
655 *	-427	246	-159	75.8	69.5	518	6.4		
665 *	-369	233	-25	30.8	71.5	437	3.7		
675 *	-133	119	-48	57.2	60.7	185	4.2		
685 *	-78	147	-96	69.4	38.2	192	0.3		

INCLOR: dec = 24.6 inc = 58.2 int = 1650 mad = 8.5



Ford Creek 6

Specimens:

38, 39 & 41 (avg), 40, 42, 43, 45, 46

In-situ:

Dec=-16.98°, Inc=60.51°

α_{95}=5.10°

k=141.07

δ_{63}=6.32°

Structurally corrected:

Dec=6.04°, Inc=70.01°

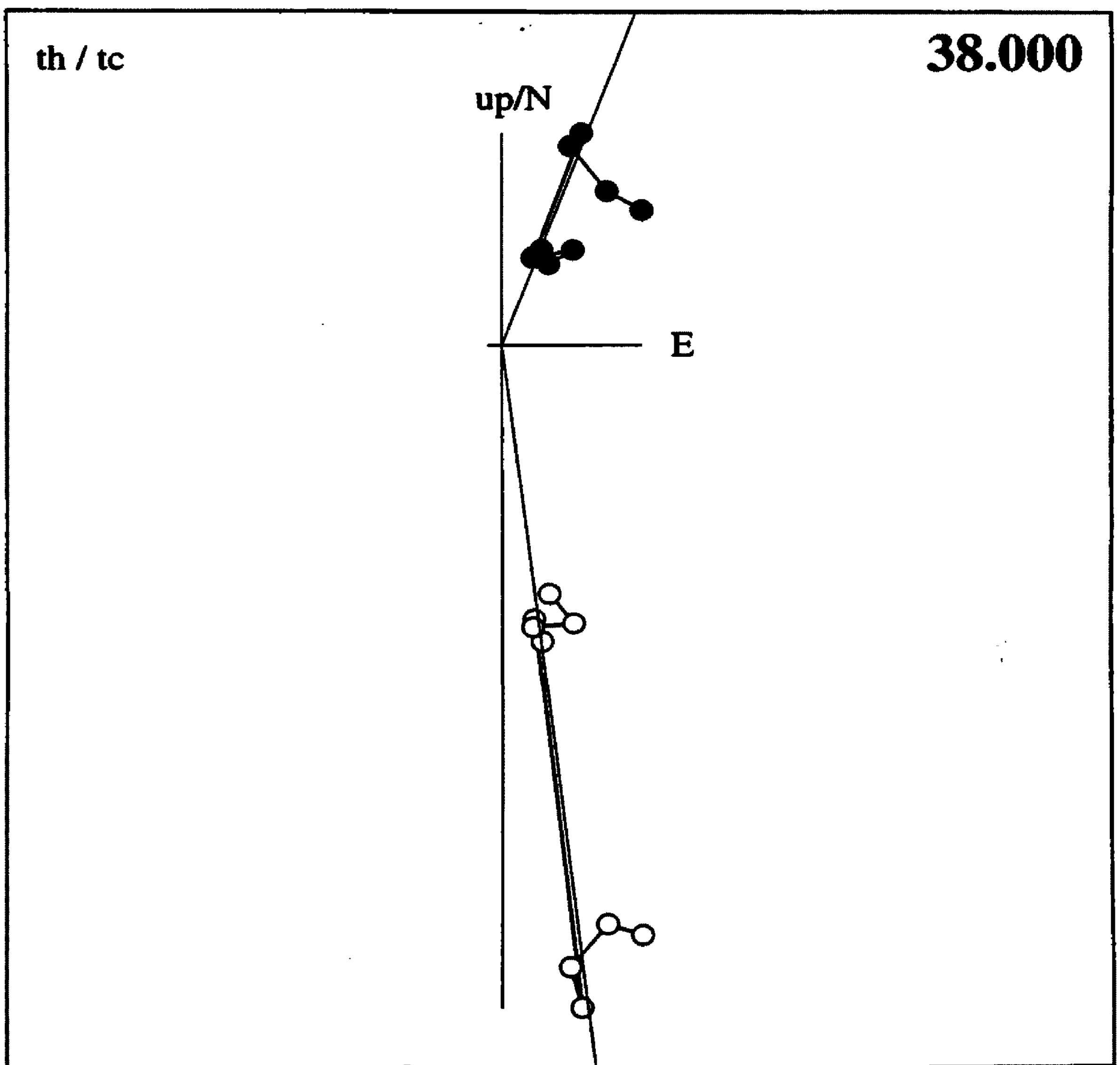
α_{95}=5.09°

k=141.68

δ_{63}=6.31°

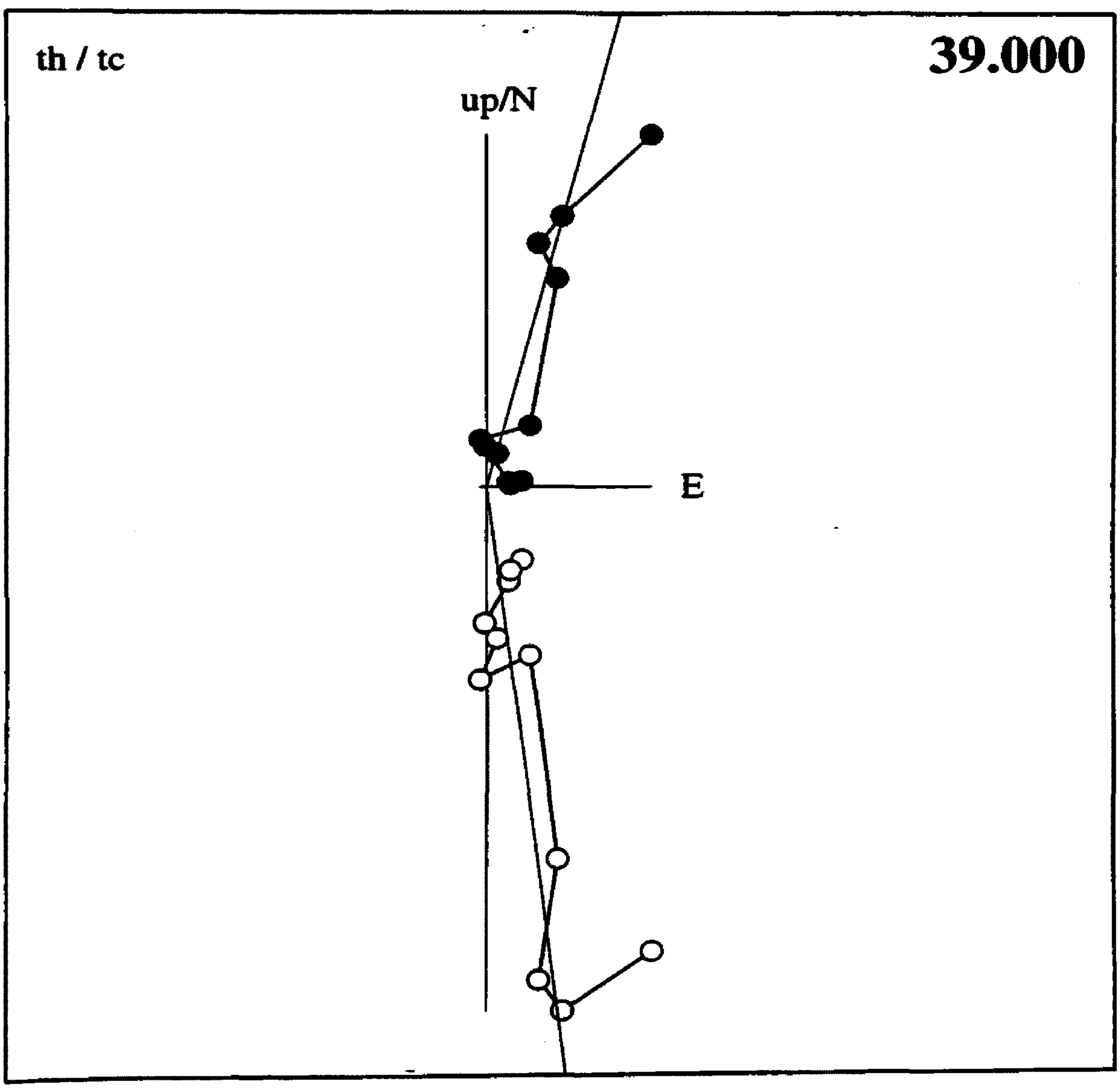
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-2277	985	-671	43.1	72.5	2570	2.9		
150	-2183	970	-801	31.7	72.5	2520	3.1		
300 *	-2275	1038	-1069	17.1	71.3	2720	2.3		
450 *	-2441	1094	-1119	18.9	71.2	2900	3.3		
550 *	-1016	457	-472	18.1	71.1	1210	2.0		
570 *	-1111	483	-497	20.8	70.8	1310	2.1		
590 *	-1037	483	-479	17.8	71.9	1240	2.0		
610 *	-1130	381	-405	34.1	67.5	1260	2.2		
610 *	-967	382	-389	27.6	69.7	1110	0.3		

INCLOR: dec = 20.0 inc = 71.0 int = 2719 mad = 1.8



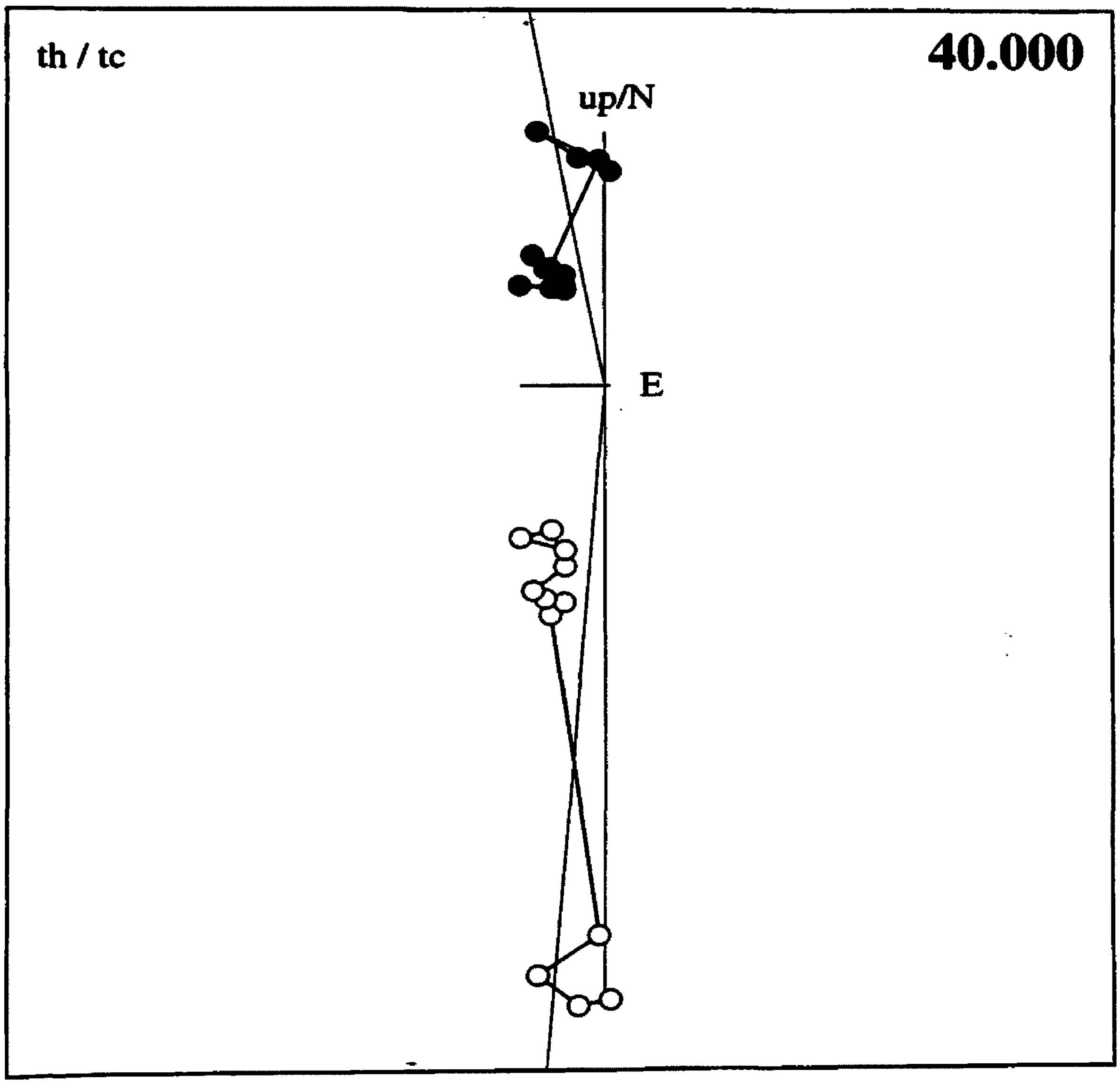
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-923	1285	997	23.0	50.3	1870	1.0		
150 *	-947	1447	630	14.2	61.7	1840	1.3		
300 *	-898	1356	528	11.0	63.1	1710	1.0		
450 *	-682	1032	517	17.0	59.4	1340	3.3		
550 *	-214	494	190	32.3	66.5	571	3.8		
570 *	-292	543	52	352.8	75.9	619	3.5		
590 *	-192	439	66	16.2	77.0	484	3.2		
610 *	-218	381	58	357.8	73.2	443	4.7		
610 *	-55	293	40	77.3	77.6	301	9.5		
640 *	-15	238	75	80.1	65.7	250	4.2		
650 *	-36	263	41	85.1	75.2	269	13.0		

INCLOR: dec = 14.4 inc = 63.6 int = 1840 mad = 6



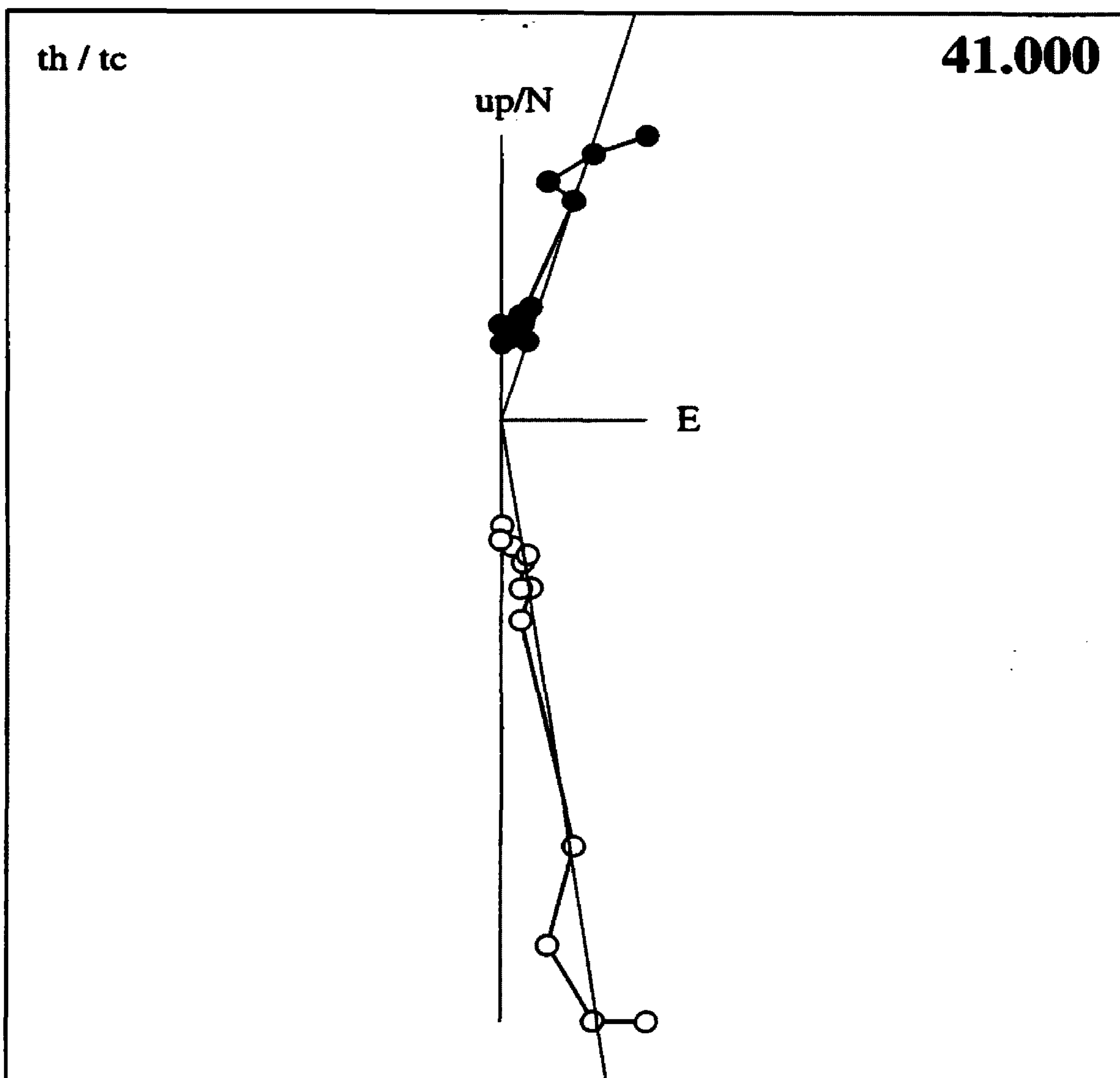
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1825	1531	-613	1.5	70.7	2460	4.1		
150 *	-1851	1512	-734	354.0	69.7	2500	2.6		
300 *	-1843	1348	-859	346.6	66.0	2440	3.2		
450 *	-1732	1302	-608	358.6	67.6	2250	2.4		
550 *	-757	483	-441	337.3	61.0	1000	4.5		
570 *	-723	459	-380	341.8	61.7	937	3.5		
590 *	-721	429	-444	335.4	58.9	949	4.1		
610 *	-736	374	-486	333.5	54.8	958	4.3		
610 *	-611	375	-339	339.6	60.5	793	1.8		
640 *	-535	251	-353	333.9	53.2	689	5.3		
650 *	-532	260	-467	322.5	50.5	754	4.4		
660 *	-590	316	-328	340.1	57.4	745	1.2		

INCLOR: dec = 349.6 inc = 66.8 int = 2460 mad = 6.3



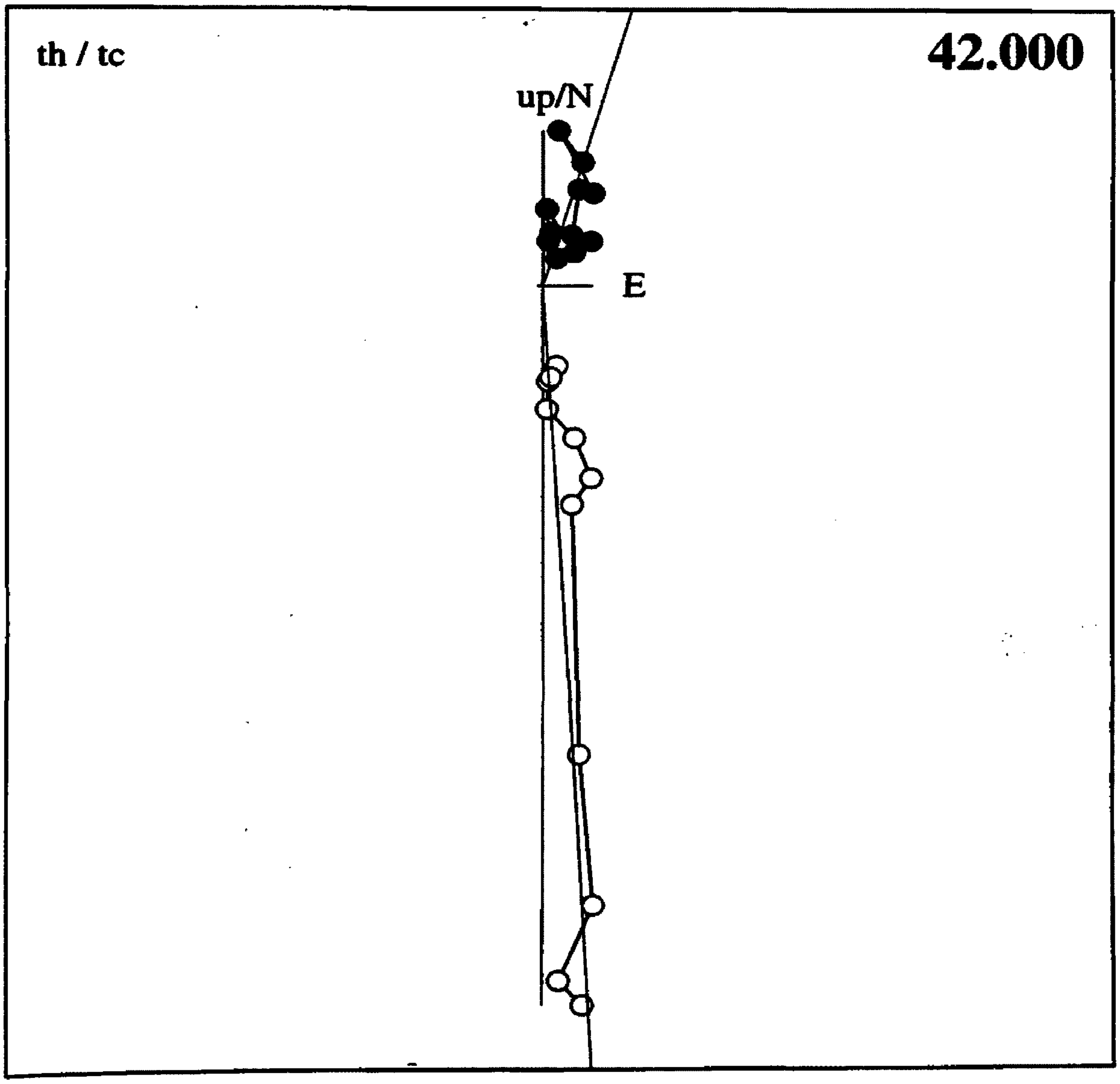
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	•	-1510	1860	512	24.8	62.3	2450	1.3		
150	•	-1500	1831	327	17.4	64.9	2390	1.1		
300	•	-1364	1572	189	10.0	65.1	2090	1.6		
450	•	-1157	1280	292	16.7	61.7	1750	2.5		
550	•	-560	589	94	9.6	62.2	818	3.8		
570	•	-544	478	152	13.2	55.1	740	3.8		
590	•	-527	480	109	9.2	57.6	721	3.7		
610	•	-465	404	117	11.2	55.5	627	2.3		
610	•	-415	355	76	6.4	56.4	551	2.1		
640	•	-377	281	48	0.2	53.8	473	2.5		
650	•	-458	310	60	359.3	51.3	556	1.3		
660	•	-395	399	115	16.7	58.4	573	4.2		

INCLOR: dec = 16.5 inc = 62.8 int = 2450 mad = 4.1



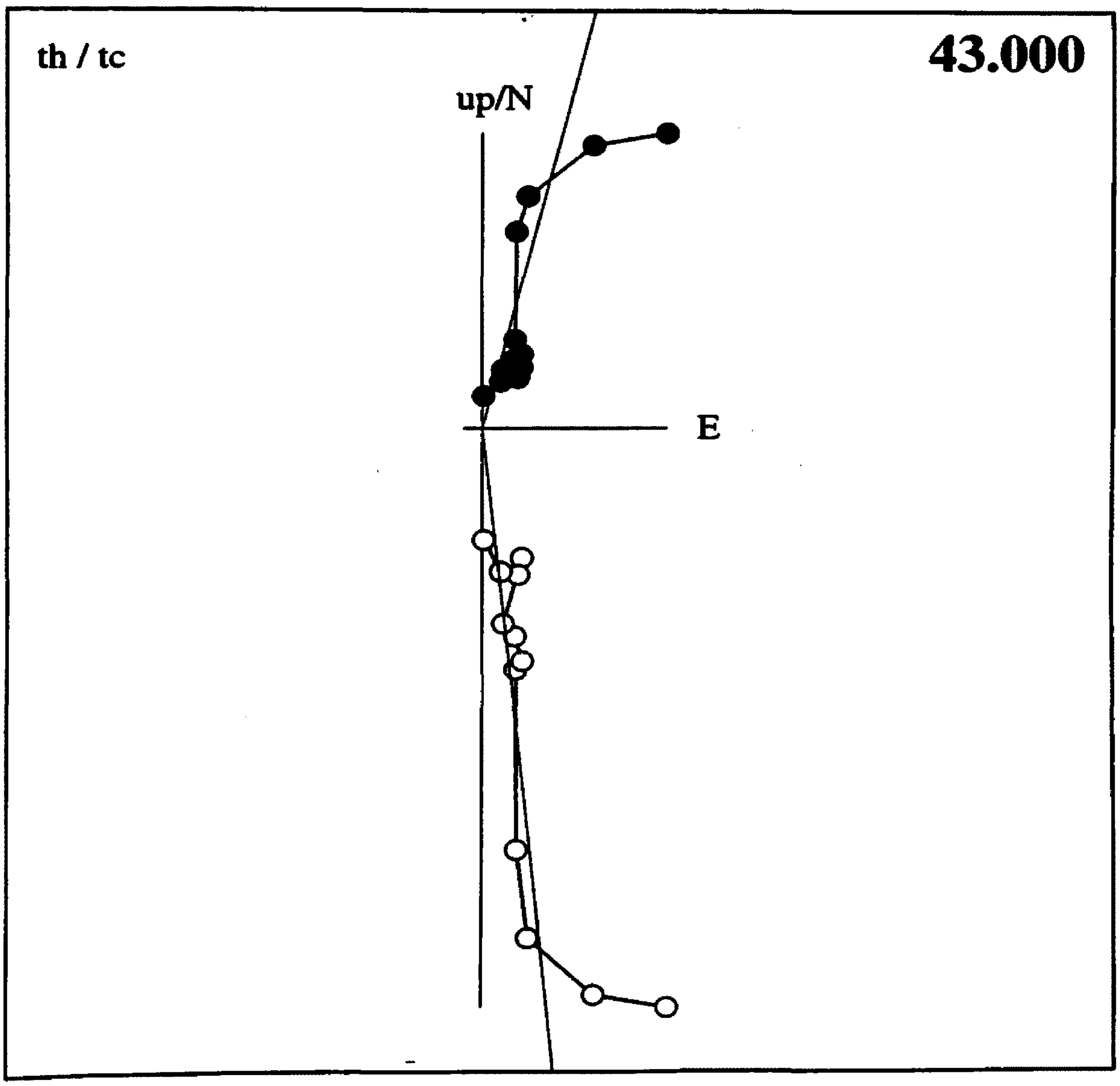
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1074	1469	-643	16.4	79.9	1930	3.3		
150 *	-1034	1392	-727	5.4	77.4	1880	3.2		
300 *	-942	1271	-503	26.5	80.5	1660	2.9		
450 *	-738	935	-441	18.7	77.8	1270	3.5		
550 *	-375	425	-202	27.6	75.5	602	3.0		
570 *	-373	359	-147	44.8	72.1	538	2.2		
590 *	-280	290	-122	40.7	73.9	421	5.4		
610 *	-240	191	-233	2.7	58.1	385	3.1		
610 *	-175	164	-146	6.3	64.8	281	6.6		
640 *	-153	142	-89	24.8	69.3	227	1.8		
650 *	-185	143	-158	8.2	59.7	282	3.9		
----	-307	232	-14	77.5	62.8	385	1.6		

INCLOR: dec = 16.4 inc = 78.4 int = 1929 mad = 3.9



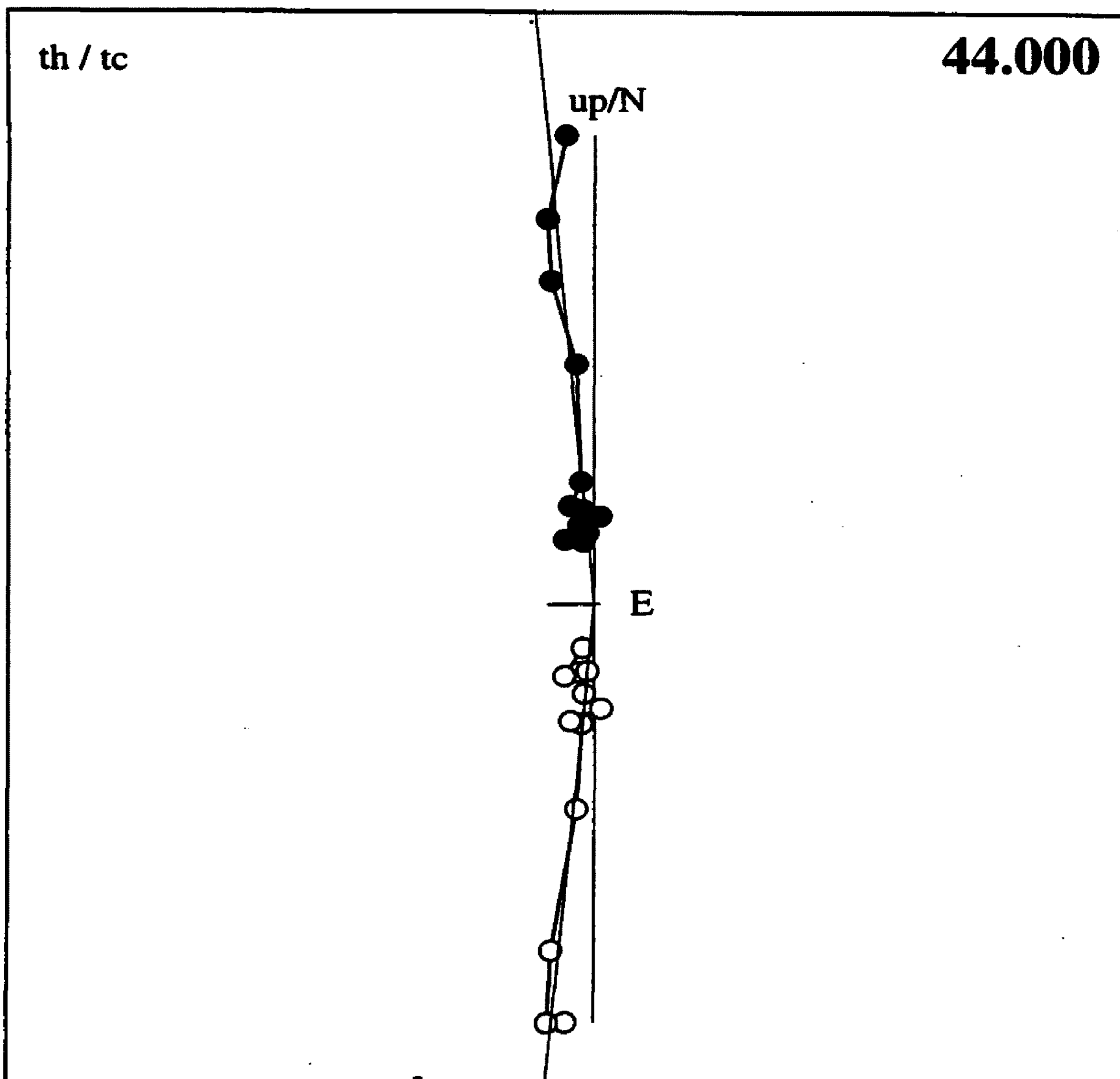
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1075	1683	923	29.7	59.5	2200	0.7		
150	-1156	1593	731	19.7	61.9	2100	0.8		
300 *	-1079	1409	485	10.3	65.1	1840	1.4		
450 *	-912	1161	402	9.0	64.7	1530	1.5		
550 *	-441	696	212	18.8	68.8	851	2.0		
570 *	-384	687	198	26.3	70.5	812	3.1		
590 *	-357	610	176	23.1	70.1	728	6.5		
610 *	-337	570	131	18.0	72.4	675	3.1		
610 *	-232	381	192	30.6	61.3	486	1.1		
640 *	-233	440	158	33.0	67.8	522	3.6		
650 *	-249	419	110	20.2	71.1	500	1.4		
660 *	-207	318	48	2.6	73.8	383	2.3		

INCLOR: dec = 13.9 inc = 66.8 int = 1840 mad = 3.9



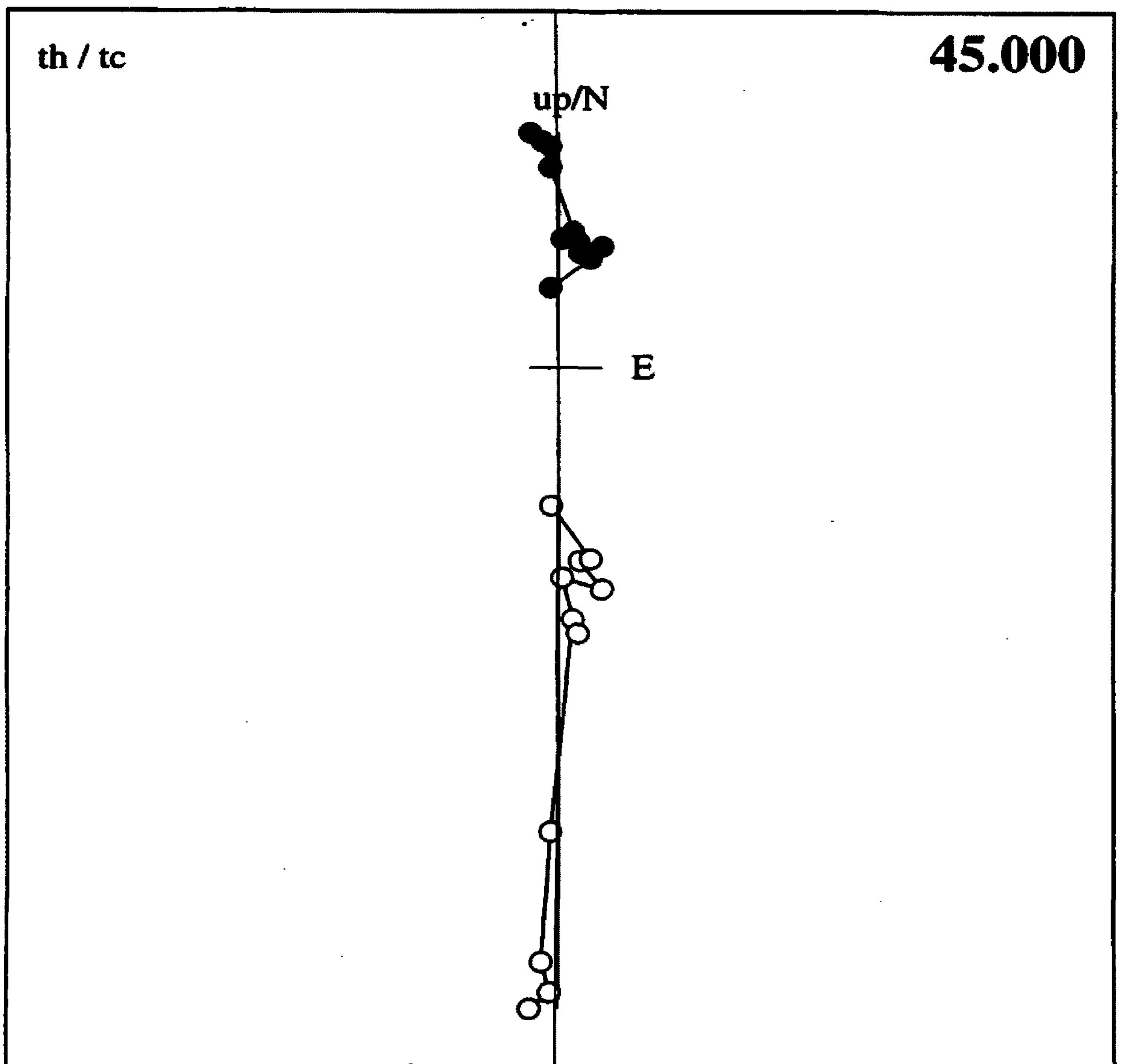
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1668	524	1432	356.8	41.4	2260	1.0		
150 *	-1593	598	1144	353.8	46.9	2050	2.7		
300 *	-1335	479	955	353.1	46.4	1710	2.6		
450 *	-844	241	728	356.2	40.3	1140	3.6		
550 *	-473	159	363	354.4	44.2	617	4.3		
570 *	-458	161	271	347.3	49.2	556	4.6		
590 *	-348	194	288	3.7	50.1	492	5.1		
610 *	-359	114	278	354.1	43.5	468	2.7		
610 *	-300	64	223	349.9	40.3	379	3.7		
640 *	-267	87	215	355.5	43.1	354	4.2		
650 *	-320	69	155	337.4	45.8	362	3.5		
660 *	-213	26	176	350.6	35.0	278	5.4		

INCLOR: dec = 354.8 inc = 44.2 int = 2260 mad = 3.5



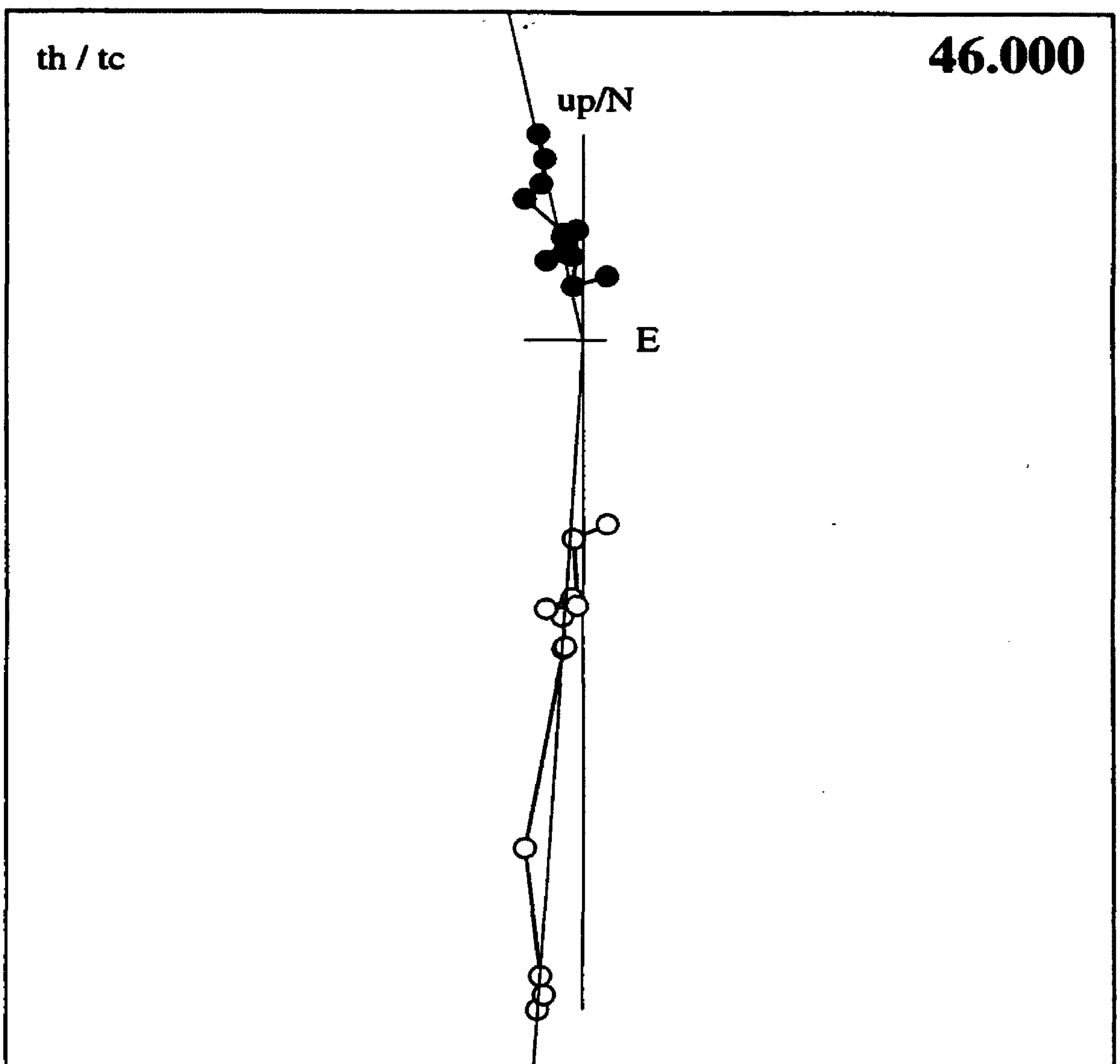
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2043	118	1195	353.7	69.7	2370	3.0		
150 *	-1996	170	1130	357.9	70.4	2300	1.7		
300 *	-1891	145	1134	356.2	69.1	2210	3.0		
450 *	-1466	139	965	357.7	66.6	1760	3.4		
550 *	-780	151	607	5.6	61.5	1000	2.7		
570 *	-835	164	580	8.1	64.4	1030	1.5		
590 *	-643	106	563	1.4	58.5	861	1.7		
610 *	-688	230	525	18.1	60.2	895	4.9		
610 *	-595	151	498	9.3	59.0	790	3.8		
640 *	-590	183	474	14.7	59.4	779	4.0		
650 *	-427	36	361	355.0	59.9	560	3.8		
----	-511	-59	373	335.1	62.9	635	4.0		

INCLOR: dec = 359.5 inc = 67.6 int = 2370 mad = 4.4



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2500	-798	284	348.9	72.5	2640	0.9		
150 *	-2447	-712	239	349.1	74.2	2560	1.8		
300 *	-2378	-647	172	346.4	75.7	2470	1.8		
450 *	-1898	-621	116	339.5	73.4	2000	2.0		
550 *	-1163	-399	164	350.7	70.7	1240	0.6		
570 *	-1155	-339	120	349.8	73.9	1210	0.8		
590 *	-1040	-385	156	349.7	69.3	1120	1.0		
610 *	-1007	-356	60	337.5	72.2	1070	0.8		
610 *	-973	-308	137	353.1	71.8	1030	1.5		
640 *	-1002	-371	215	357.2	67.4	1090	1.9		
650 *	-751	-211	76	350.9	74.5	784	0.7		
660 *	-704	-158	190	18.7	69.8	746	2.3		

INCLOR: dec = 348.3 inc = 73.3 int = 2639 mad = 2.6



Ford Creek 7

Specimens:

47, 48, 49, 50, 51, 52, 53, 55

In-situ:

Dec=20.46°, Inc=32.72°

α_{95}=8.88°

k=39.88

δ_{63}=12.02°

Structurally corrected:

Dec=-6.69°, Inc=64.28°

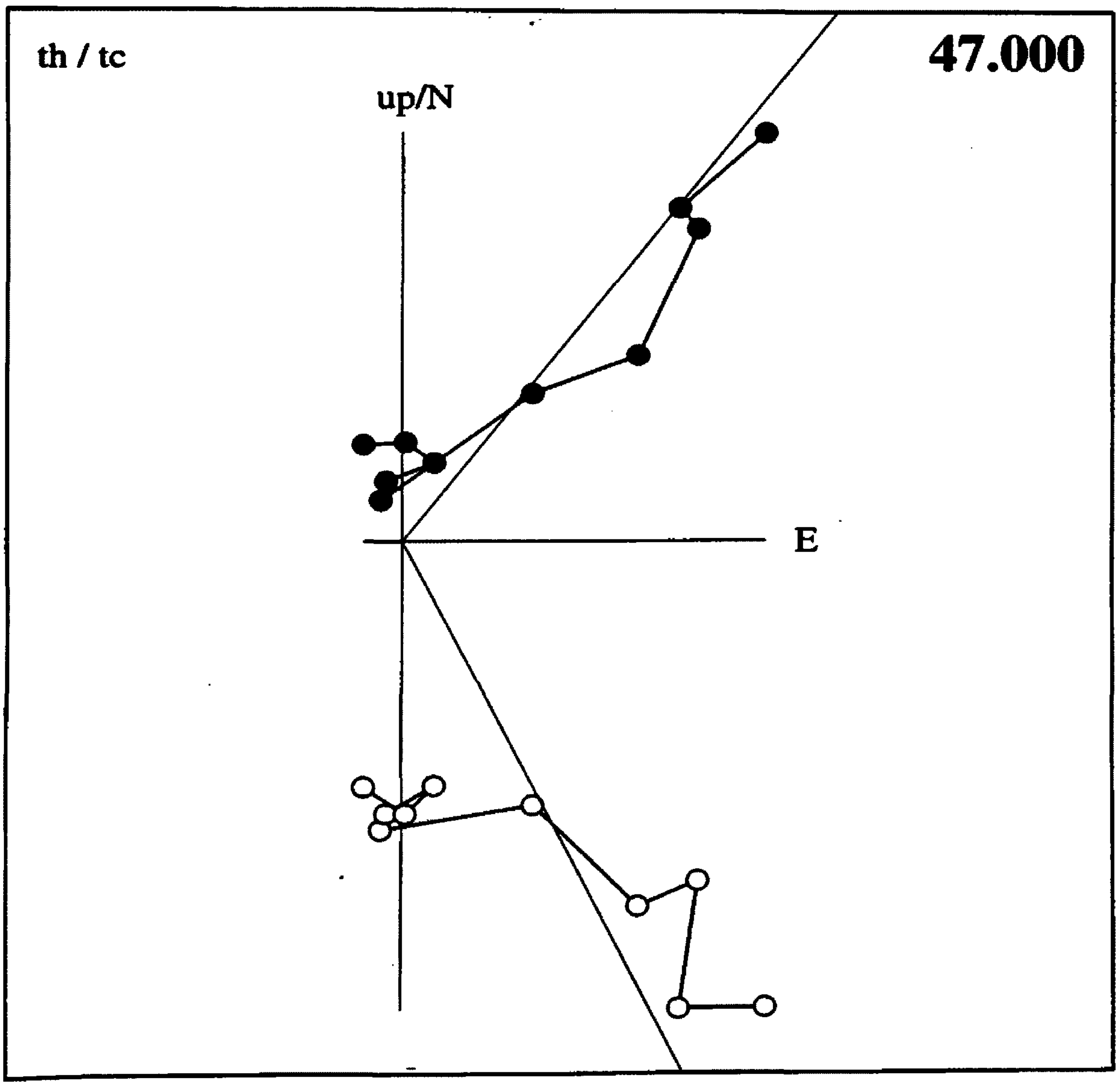
α_{95}=8.87°

k=39.92

δ_{63}=12.02°

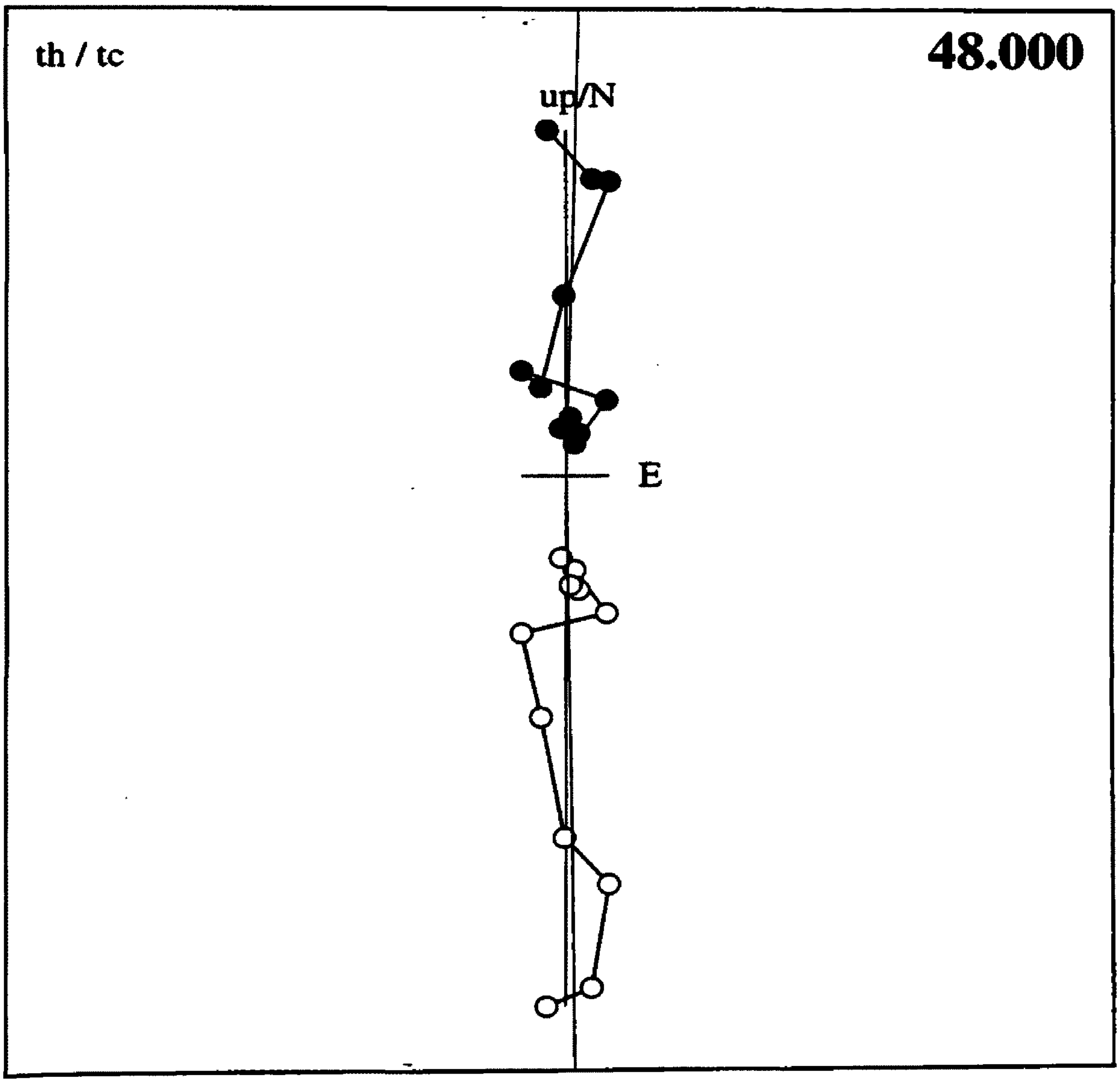
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-476	-669	86	38.8	41.3	826	1.9		
150 *	-492	-544	64	36.9	47.9	736	4.4		
300 *	-343	-522	79	40.5	39.2	629	2.9		
450 *	-383	-366	119	48.9	51.9	543	1.8		
550 *	-283	-252	42	38.6	54.1	381	3.4		
----	-386	-39	-210	306.6	55.5	441	2.9		
590 *	-336	-59	-11	335.1	80.9	341	0.8		
----	-633	345	-342	261.1	44.3	798	2.1		
630 *	-316	-79	-21	346.9	77.1	326	1.0		
640 *	-276	-123	3	20.4	70.8	302	7.7		
650 *	-312	-128	-32	1.7	69.8	339	2.4		
660 *	-287	-96	-69	340.3	67.1	311	3.6		

INCLOR: dec = 36.6 inc = 50.9 int = 826 mad = 14.9



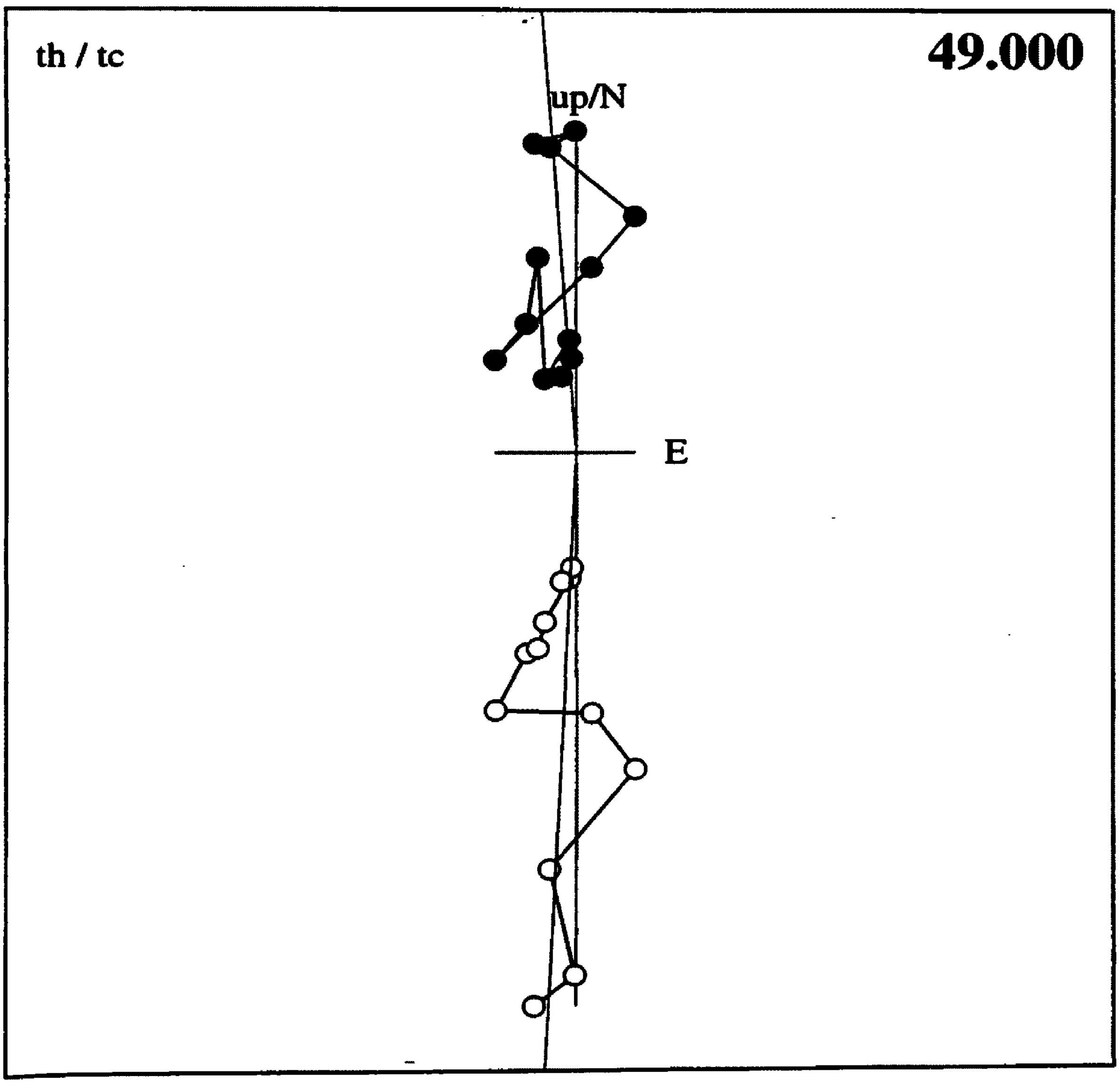
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1175	-715	-259	357.2	56.6	1400	0.6		
150 *	-1119	-668	-133	4.5	59.5	1310	2.4		
300 *	-891	-665	-135	7.6	53.8	1120	1.3		
450 *	-800	-396	-93	359.5	63.4	897	0.9		
550 *	-541	-177	-64	345.4	69.3	573	12.0		
570 *	-365	-176	-144	339.1	54.5	430	2.0		
590 *	-292	-208	26	26.0	58.5	359	2.4		
----	-235	206	58	206.4	45.4	318	2.8		
630 *	-206	-86	9	14.1	70.5	223	8.3		
640 *	-249	-111	10	15.1	69.0	273	4.8		
650 *	-242	-132	-23	4.1	62.0	277	5.2		
660 *	-185	-97	-36	354.4	59.9	212	4.0		

INCLOR: dec = 1.4 inc = 58.8 int = 1399 mad = 5.6



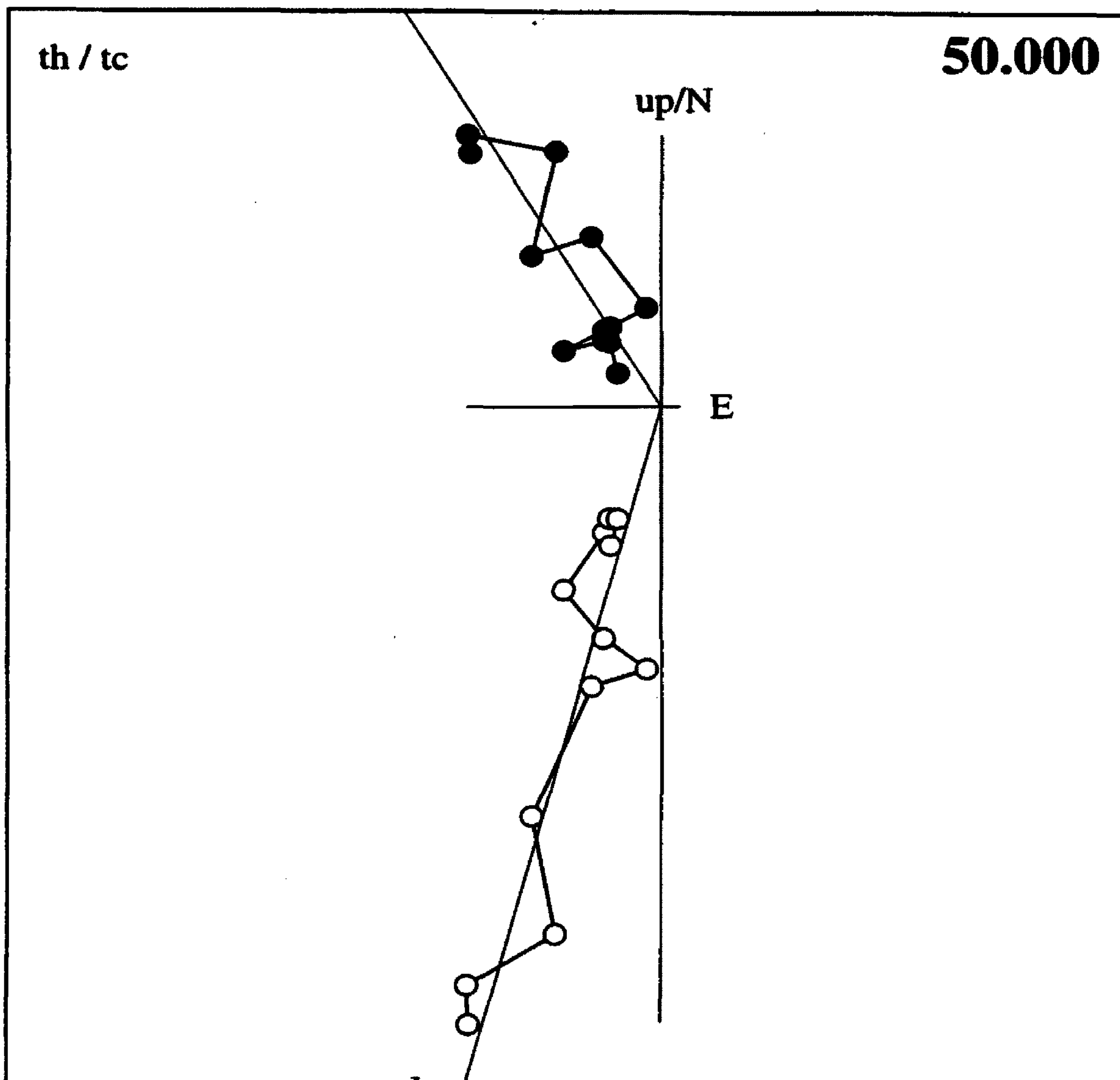
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1056	-425	-345	353.0	60.4	1190	2.6		
150 *	-995	-486	-309	359.8	58.2	1150	1.8		
300 *	-804	-432	-338	355.5	53.6	973	1.1		
450 *	-603	-419	-157	12.7	52.5	751	1.9		
550 *	-499	-295	-162	4.3	54.5	602	0.9		
570 *	-498	-57	-182	321.6	65.3	533	1.2		
590 *	-390	-142	-190	340.7	55.7	456	2.4		
610 *	-383	-251	-254	349.9	44.5	524	1.9		
630 *	-325	-79	-105	338.9	65.0	351	1.9		
640 *	-244	-162	-125	356.9	48.0	319	4.6		
650 *	-223	-137	-102	357.5	50.6	281	4.0		
660 *	-249	-99	-91	350.2	59.2	283	1.9		

INCLOR: dec = 356.0 inc = 57.1 int = 1190 mad = 7.1



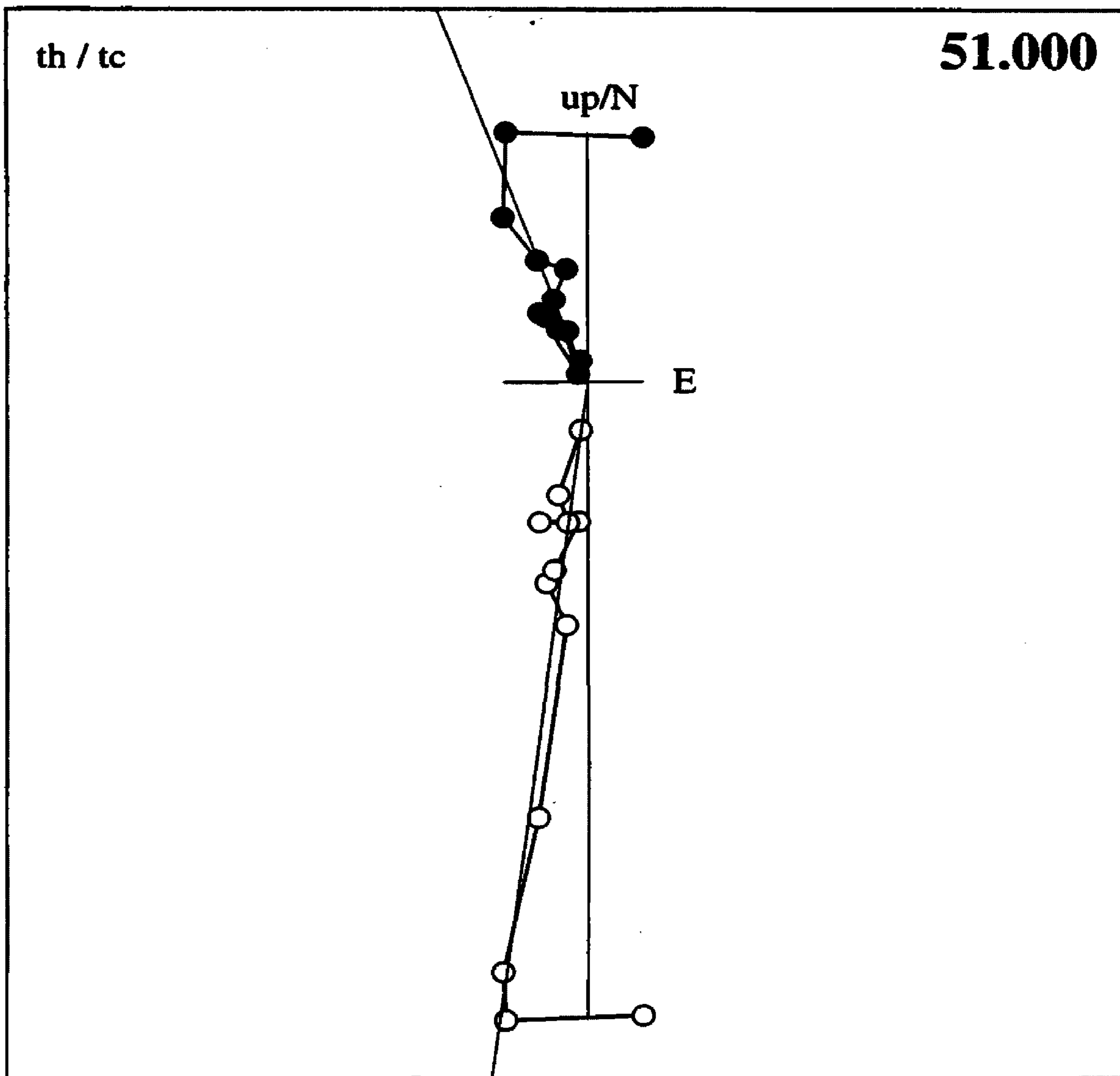
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2112	-570	-831	325.7	63.3	2340	1.4		
150 *	-1980	-599	-885	327.2	60.5	2250	1.9		
300 *	-1779	-701	-650	339.5	62.5	2020	1.2		
450 *	-1411	-329	-521	322.3	64.8	1540	2.5		
550 *	-949	-442	-452	339.8	56.9	1140	1.5		
570 *	-880	-346	-173	352.4	69.0	961	1.4		
590 *	-796	-193	-238	326.0	68.1	853	1.3		
610 *	-653	-43	-306	302.6	60.2	722	3.4		
630 *	-442	-123	-245	322.2	56.2	520	2.0		
640 *	-481	-178	-254	330.3	56.4	572	1.2		
650 *	-391	-124	-234	324.2	54.1	472	5.1		
660 *	-395	-54	-146	310.3	65.3	424	2.0		

INCLOR: dec = 329.5 inc = 62.6 int = 2339 mad = 4.9



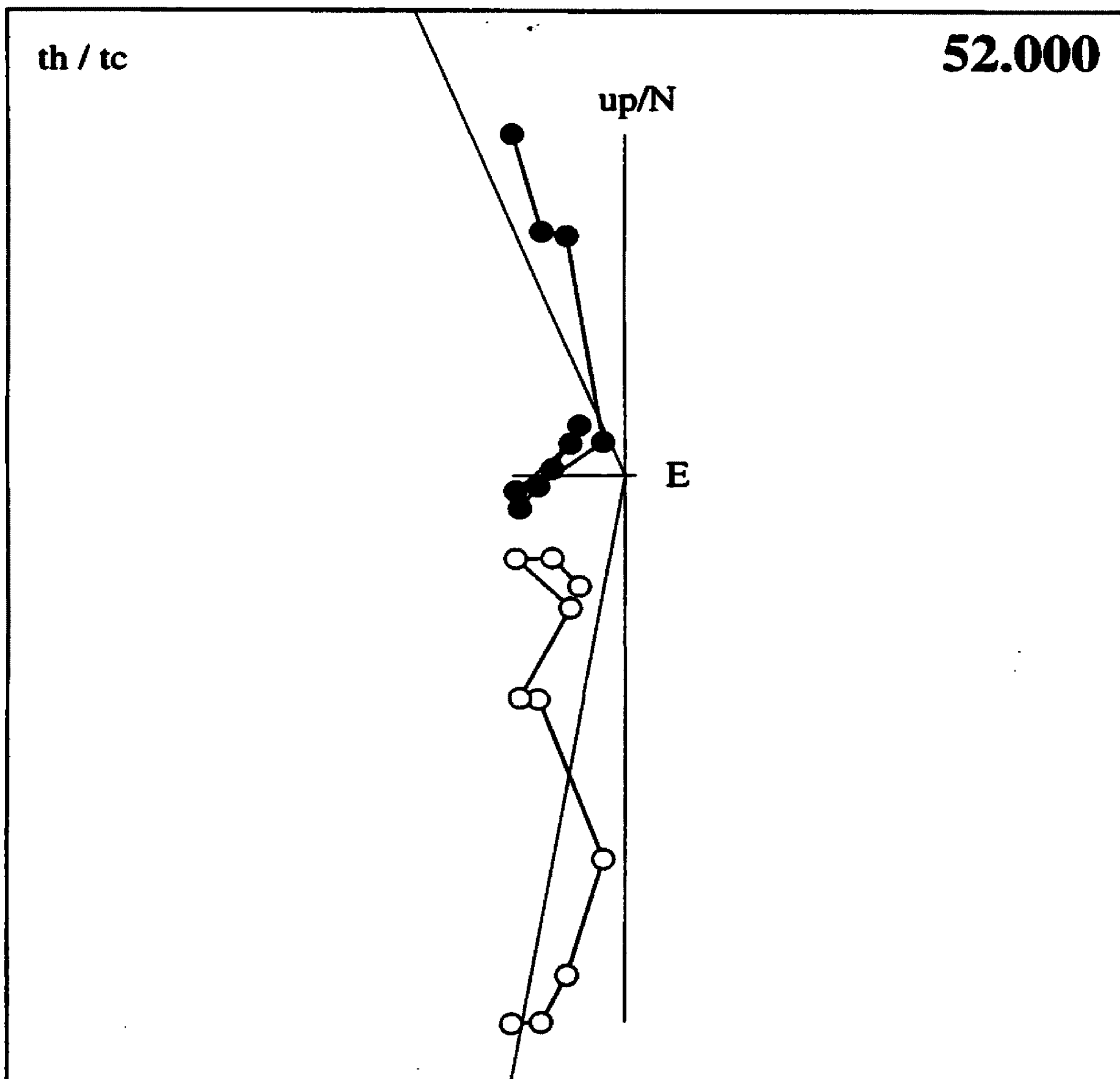
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-1857	-851	-391	11.6	68.3	2080	1.7		
150 *	-1894	-602	-678	343.5	67.6	2100	1.0		
300 *	-1768	-392	-505	335.0	72.7	1880	0.5		
450 *	-1308	-315	-349	339.6	73.3	1390	1.7		
550 *	-722	-289	-277	350.3	64.7	826	2.5		
570 *	-611	-131	-217	330.2	69.5	661	7.4		
590 *	-566	-181	-238	339.9	65.0	640	2.3		
610 *	-427	-44	-33	312.1	85.2	431	3.7		
630 *	-424	-107	-242	327.7	59.6	500	2.0		
640 *	-425	-121	-146	340.5	68.9	465	0.8		
650 *	-341	-99	-168	333.5	62.4	393	2.9		
660 *	-144	-49	-59	343.0	65.0	163	4.2		

INCLOR: dec = 339.9 inc = 69.9 int = 2100 mad = 4.2



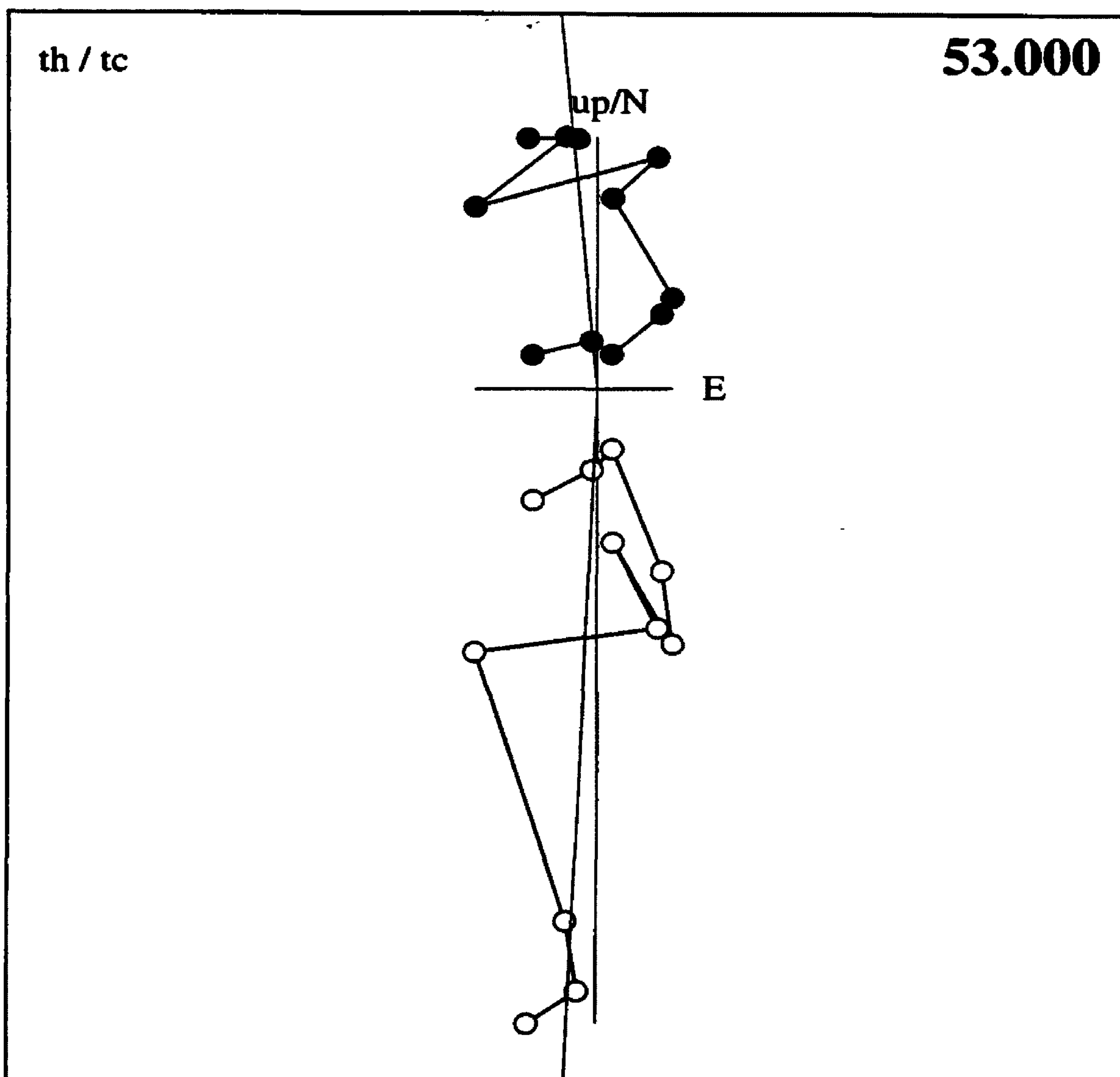
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1059	-721	-152	343.3	56.7	1290	0.8		
150 *	-1049	-562	-32	342.9	64.7	1190	1.3		
300 *	-949	-557	-13	347.7	63.6	1100	1.3		
450 *	-731	-164	141	329.5	84.2	762	1.4		
550 *	-470	7	-12	262.1	70.4	470	4.1		
570 *	-480	59	-25	251.0	65.6	484	2.8		
590 *	-278	-65	-41	303.2	66.1	288	1.4		
610 *	-218	73	-119	261.0	39.5	259	2.4		
630 *	-195	9	-77	275.7	51.3	210	8.4		
640 *	-231	-97	-52	320.6	59.7	256	9.2		
----	-227	91	16	221.1	57.3	245	15.9		

INCLOR: dec = 337.8 inc = 65.7 int = 1289 mad = 13.1



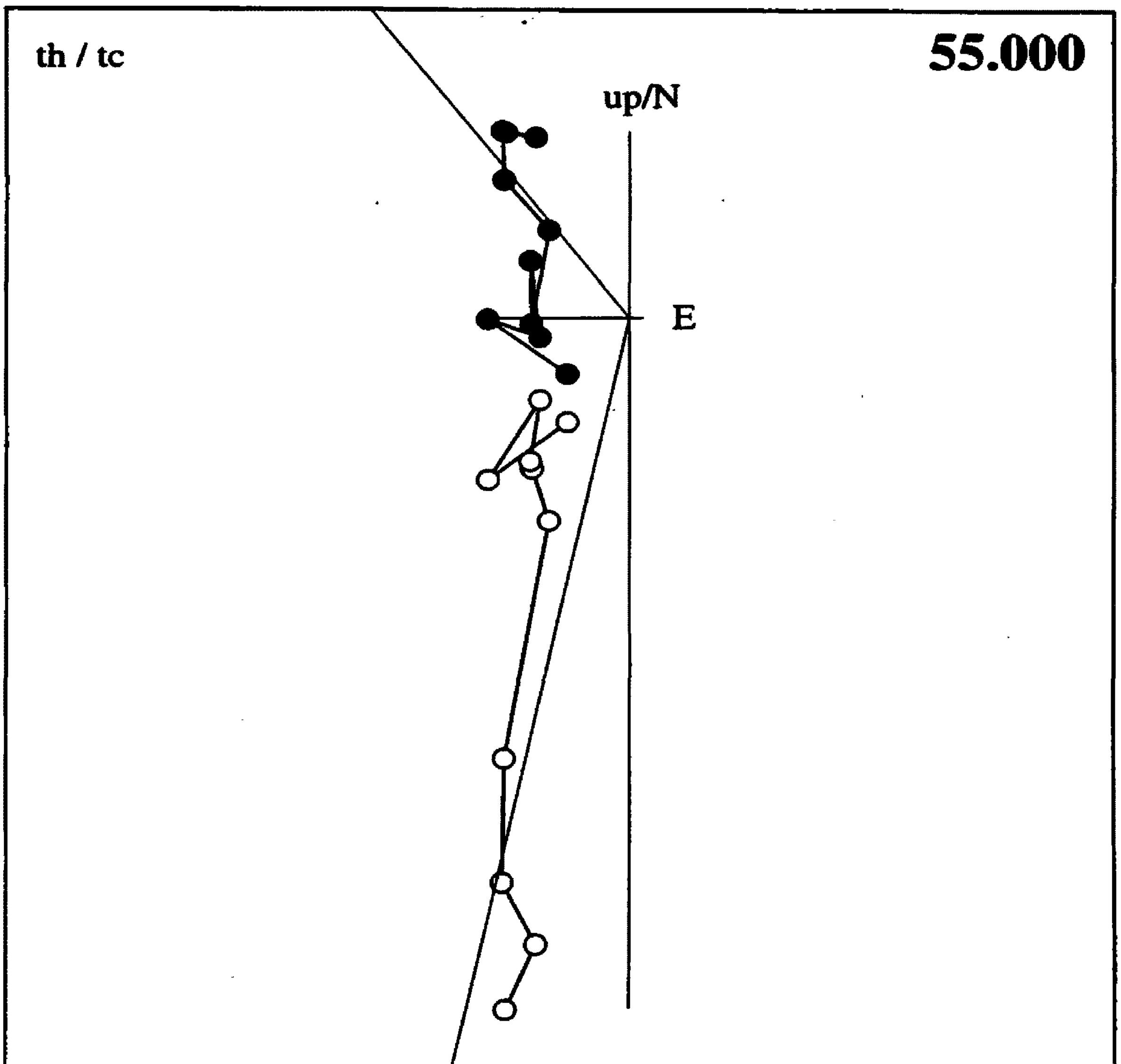
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-1779	-644	-382	346.0	67.6	1930	0.9		
150 *	-1673	-710	-287	356.1	67.2	1840	0.4		
300 *	-1488	-679	-335	353.7	64.4	1670	1.3		
450 *	-771	-307	-481	328.9	50.9	959	2.2		
550 *	-640	-690	-196	13.3	45.1	961	0.9		
570 *	-416	-503	-246	4.1	38.7	698	3.8		
590 *	-687	-393	76	36.8	66.0	795	1.0		
610 *	-488	-321	60	37.9	62.4	587	2.3		
630 *	-162	-118	-10	21.3	58.5	201	2.9		
640 *	-227	-125	-68	354.6	59.1	268	2.1		
650 *	-335	-13	-157	300.7	58.9	370	3.0		

INCLOR: dec = 355.1 inc = 63.9 int = 1929 mad = 10.8



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-2333	-608	-375	329.0	72.4	2440	1.4		
150 *	-2108	-618	-318	334.9	72.2	2220	1.0		
300 *	-1924	-553	-440	328.4	68.6	2050	1.3		
450 *	-1518	-364	-393	320.5	67.9	1610	2.5		
550 *	-711	-197	-284	320.2	60.7	791	1.7		
570 *	-557	116	-169	266.1	59.6	593	2.0		
590 *	-526	-54	-297	302.4	53.5	606	0.9		
----	-693	605	418	188.6	40.5	1010	2.5		
630 *	-324	169	-152	256.6	44.6	396	10.6		
640 *	-617	172	-283	269.6	51.7	700	3.7		
650 *	-389	216	-4	225.0	52.8	445	11.0		

INCLOR: dec = 323.0 inc = 70.4 int = 2440 mad = 8.7



Ford Creek 8

Specimens:

58, 59, 60, 61, 64

In-situ:

Dec=-24.92°, Inc=50.90°

α_{95}=17.60°

k=19.85

δ_{63}=16.32°

Structurally corrected:

Dec=-23.03°, Inc=60.42°

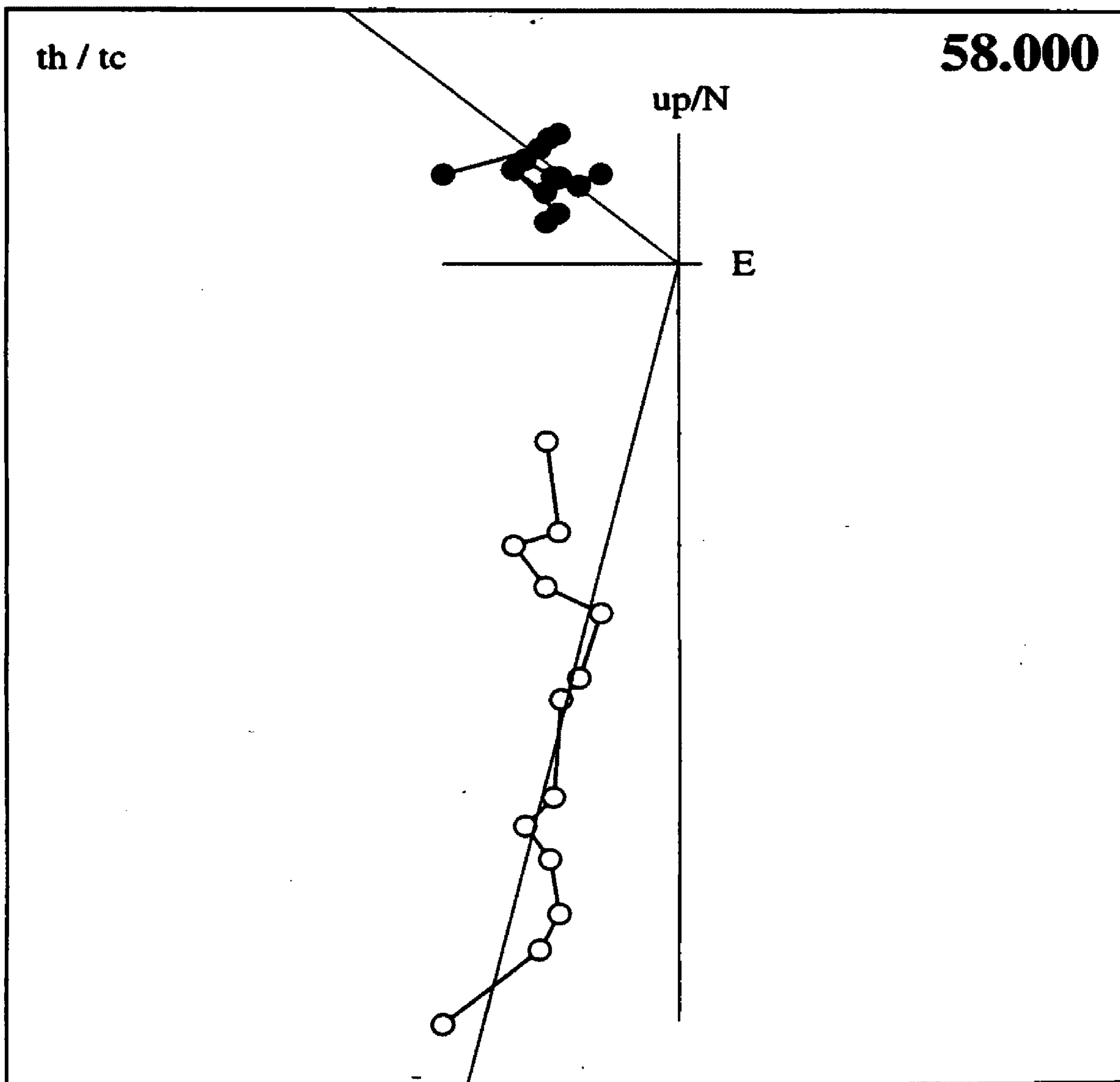
α_{95}=16.11°

k=23.52

δ_{63}=14.99°

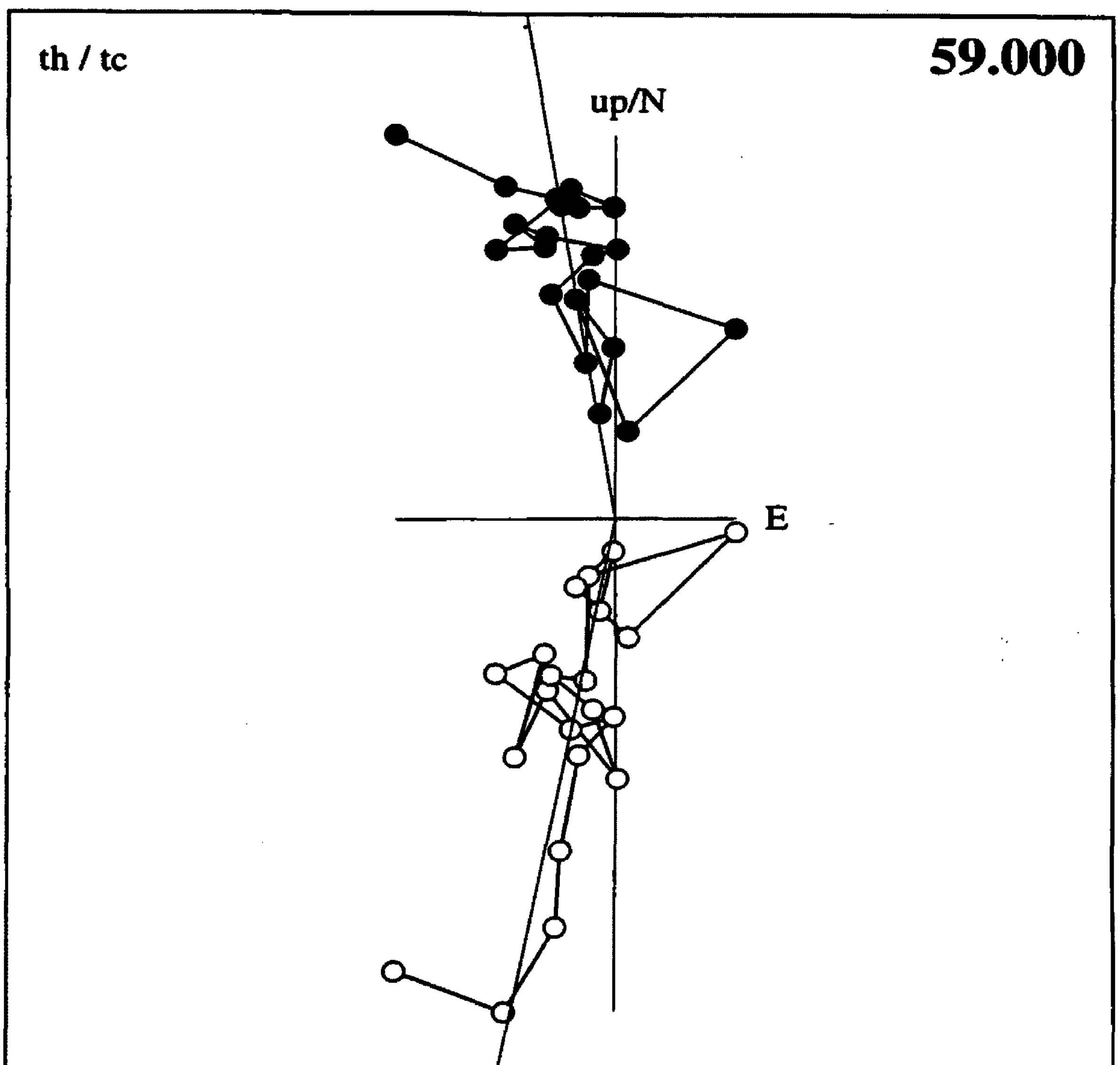
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-474	1	-124	292.6	73.0	490	2.1		
2 *	-432	-7	-66	312.3	76.0	437	1.0		
4 *	-412	-17	-53	320.1	75.4	416	2.9		
6 *	-379	-22	-58	316.8	73.9	384	1.5		
8 *	-357	-18	-74	306.5	72.8	365	3.1		
10 *	-337	-6	-62	307.1	75.0	343	3.5		
14 *	-278	-17	-56	308.7	72.4	284	9.6		
18 *	-264	-12	-47	310.7	74.0	268	1.1		
22 *	-226	-23	-32	321.7	72.0	229	1.1		
26 *	-208	-24	-65	300.4	66.5	219	3.2		
30 *	-186	-47	-78	302.0	57.9	207	3.8		
36 *	-172	-16	-61	294.6	65.9	183	4.2		
42 *	-116	-24	-67	289.1	54.5	136	7.1		

INCLOR: dec = 310.0 inc = 73.0 int = 437 mad = 5



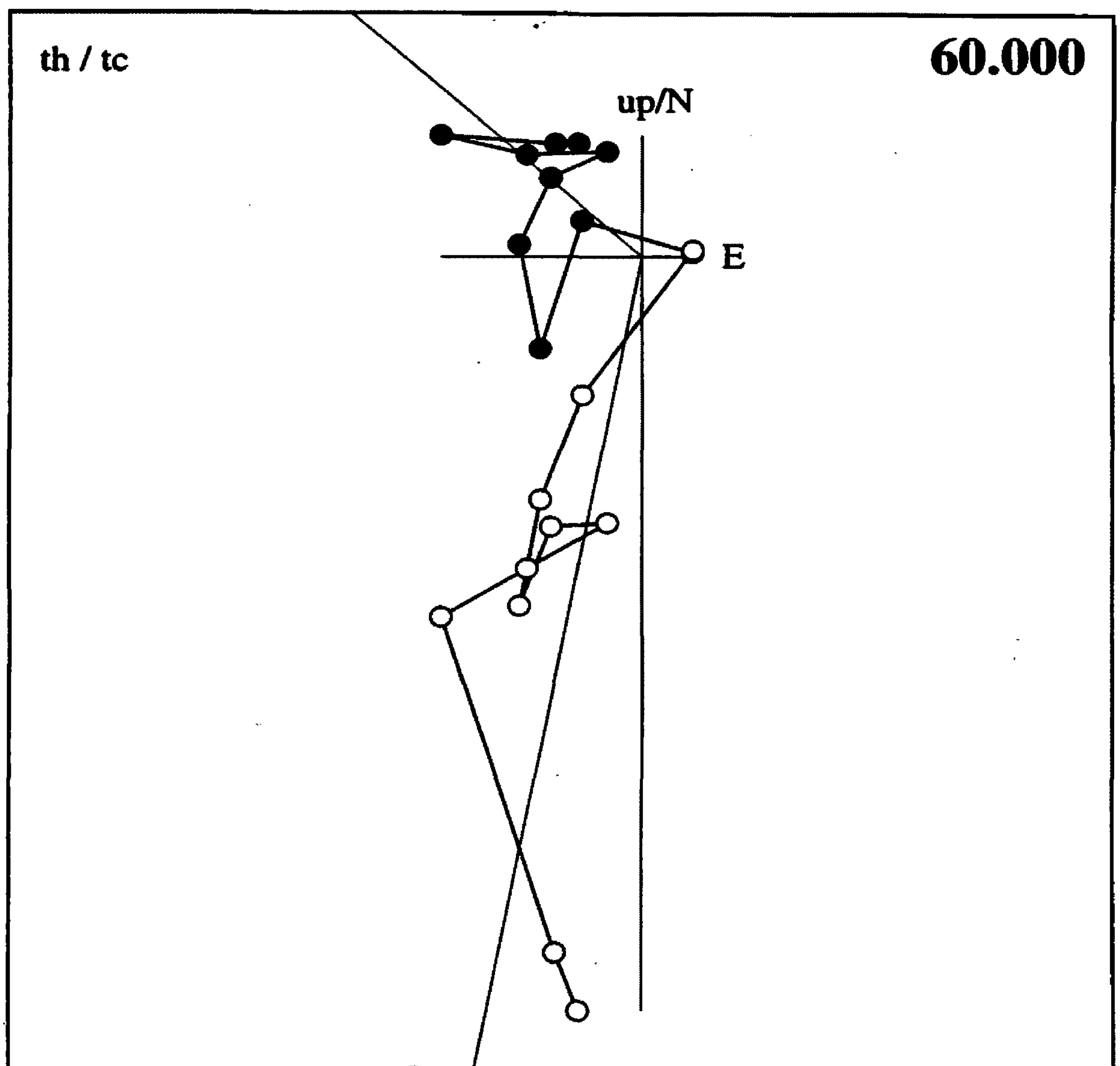
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-707	-135	-338	332.7	45.9	795	2.6		
2 •	-734	-54	-213	343.4	54.4	766	0.9		
4 •	-642	-95	-144	350.5	51.1	665	1.3		
6 •	-556	-135	-129	351.1	46.0	587	3.0		
8 •	-454	-194	-98	353.9	36.8	503	1.8		
10 •	-417	-219	-53	359.7	32.3	474	2.4		
12 •	-436	-231	-105	353.0	32.2	504	3.2		
16 •	-325	-198	-179	338.2	27.8	421	3.0		
20 •	-313	-214	-121	346.7	25.6	398	6.3		
24 •	-436	-174	-170	342.9	37.3	499	3.1		
28 •	-359	-203	-124	347.6	30.4	431	3.8		
32 •	-458	-133	-52	0.3	43.8	480	3.6		
36 •	-375	-171	-72	355.5	35.5	418	2.1		
42 •	-307	-149	-112	345.5	33.7	359	2.2		
48 •	-273	-70	-67	350.3	45.3	290	3.4		
54 •	-213	-229	-58	354.3	13.4	318	5.1		
60 •	-153	-205	121	29.9	3.6	283	1.8		
68 •	-189	-22	-8	7.0	53.1	190	3.4		
78 •	-211	-200	-73	350.8	17.0	300	3.1		
88 •	-146	-170	-21	359.4	10.8	225	4.3		
98 •	-167	-58	-38	352.4	40.7	181	4:8		

INCLOR: dec = 350.9 inc = 39.4 int = 766 mad = 13.5



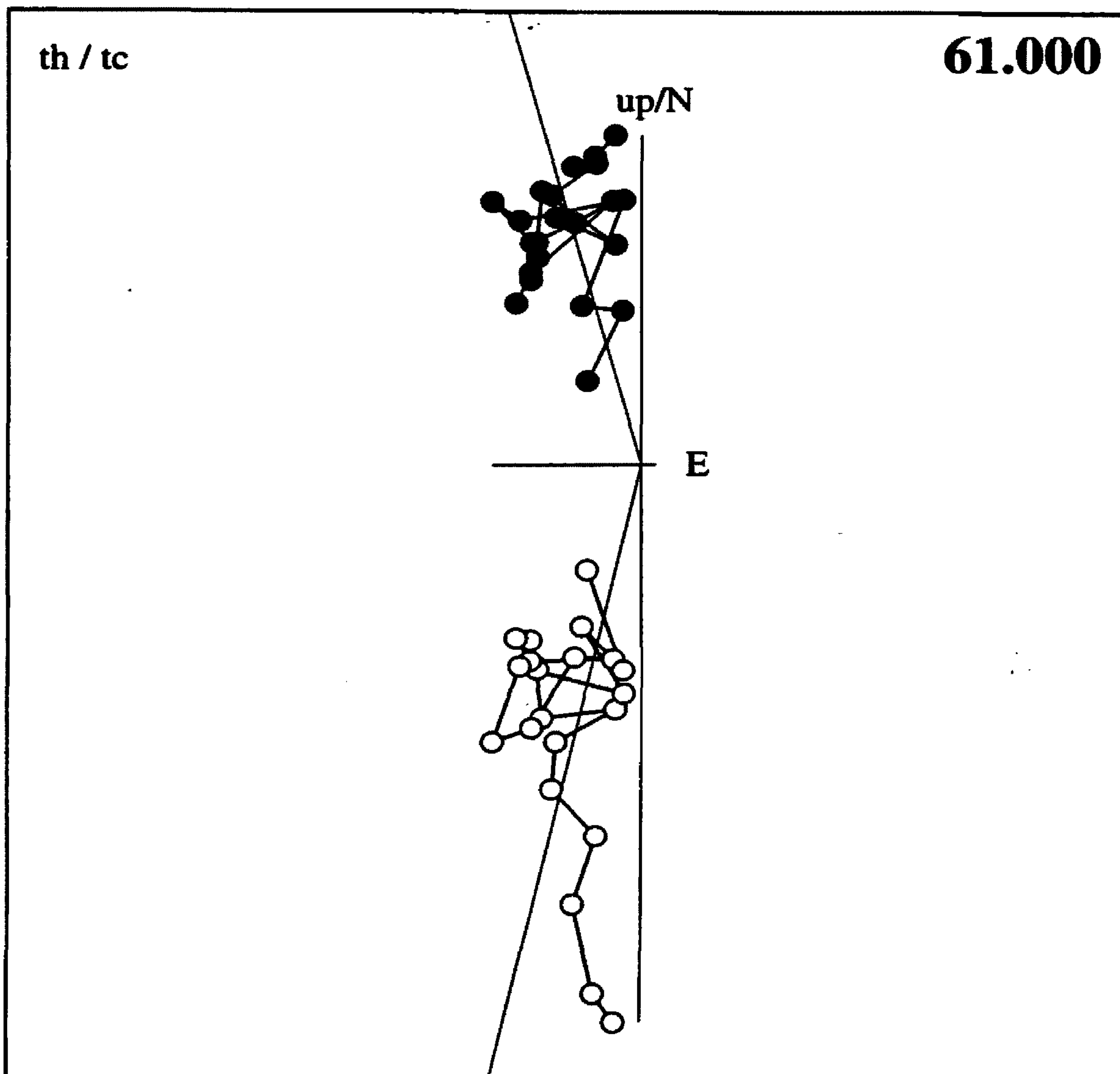
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
150 *	-2248	244	-743	333.0	80.4	2380	2.4		
300 *	-2058	251	-765	324.9	78.8	2210	2.8		
----	-2131	504	-9	142.7	80.2	2190	3.0		
550 *	-974	221	-862	303.6	58.8	1320	4.1		
570 *	-885	106	-609	314.2	65.0	1080	2.6		
590 *	-803	-56	-412	343.1	67.7	904	2.8		
610 *	-772	103	-491	313.5	67.2	921	3.5		
630 *	-978	366	-481	276.1	72.2	1150	2.7		
640 *	-657	535	-186	225.1	61.9	867	2.3		
650 *	-386	85	-273	303.2	64.9	481	1.7		
660 *	-16	-94	111	85.6	-8.0	147	7.9		

INCLOR: dec = 312.7 inc = 75.7 int = 2380 mad = 10.7



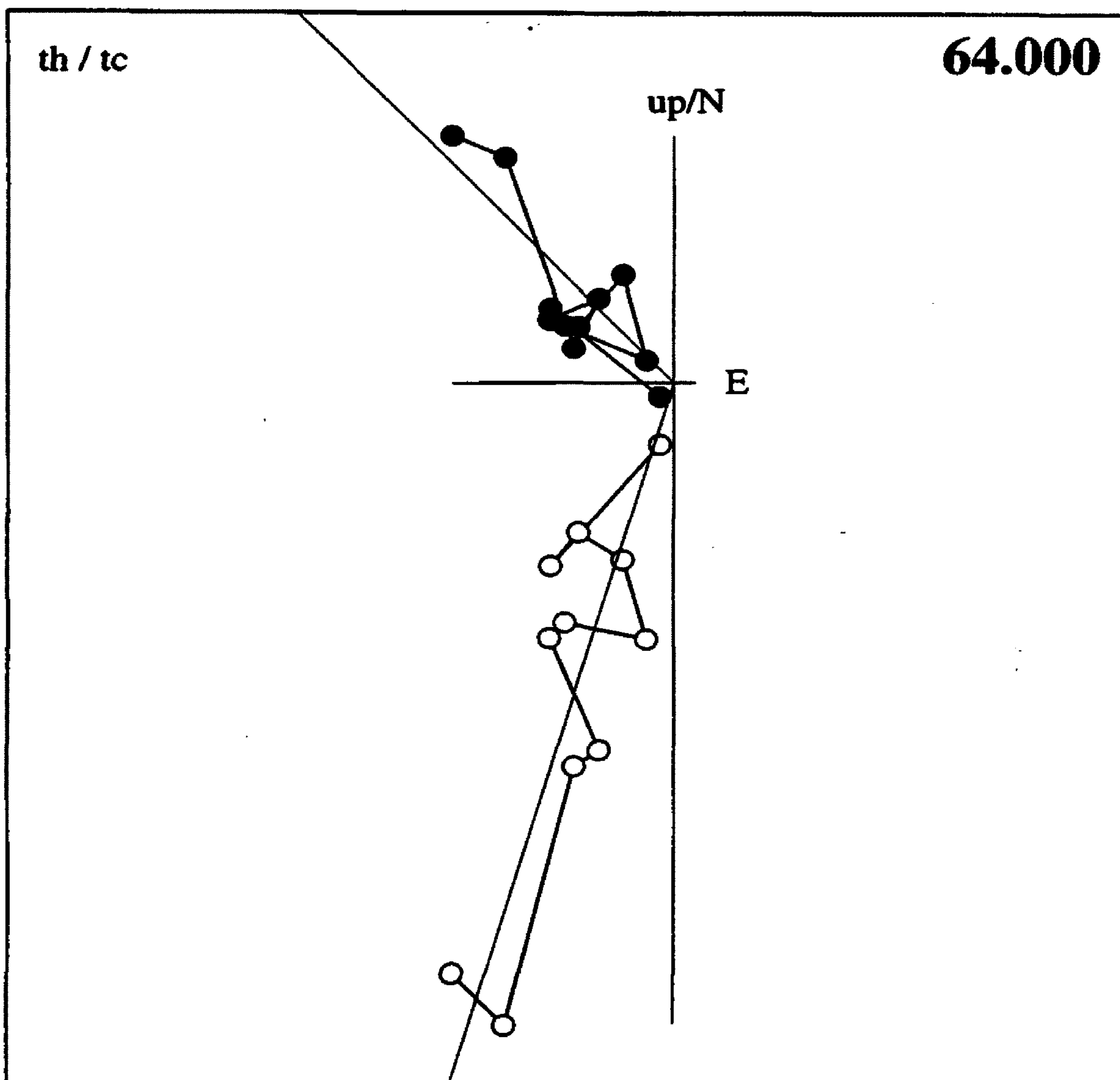
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-811	-288	-329	355.9	59.1	922	1.8		
2 *	-763	-257	-336	352.1	59.3	873	3.3		
4 *	-634	-254	-337	348.3	55.1	762	3.6		
6 *	-546	-285	-298	352.2	50.5	684	2.3		
8 *	-464	-233	-323	343.2	48.8	612	3.4		
10 *	-398	-218	-296	342.6	46.7	542	4.0		
12 *	-365	-219	-204	354.0	47.7	472	3.3		
14 *	-365	-251	-323	341.7	41.2	548	3.4		
16 *	-284	-194	-290	336.9	39.6	450	2.9		
18 *	-242	-148	-270	331.7	39.7	392	3.8		
20 *	-288	-174	-281	335.7	41.8	438	2.5		
24 *	-232	-111	-274	325.0	41.1	376	4.9		
28 *	-272	-152	-279	332.4	42.0	418	3.4		
32 *	-301	-286	-222	354.4	36.2	471	5.3		
36 *	-285	-240	-254	346.0	37.6	451	3.3		
40 *	-369	-177	-308	335.9	47.0	512	1.7		
46 *	-383	-208	-380	332.9	42.9	578	4.4		
52 *	-283	-214	-321	335.8	36.8	479	5.2		
72 *	-352	-285	-217	356.5	40.7	502	4.6		
82 *	-233	-142	-193	341.4	43.9	334	3.5		
92 *	-304	-145	-151	353.7	52.8	369	2.8		
100 *	-145	-59	-132	329.7	47.3	205	2.9		

INCLOR: dec = 345.1 inc = 49.0 int = 922 mad = 9.7



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0 *	-886	-49	-482	320.9	61.5	1010	3.3		
150 *	-965	-10	-414	325.9	66.9	1050	2.0		
300 *	-543	137	-212	291.1	75.8	599	3.4		
450 *	-544	53	-194	321.2	73.5	580	0.7		
550 *	-363	49	-232	299.3	63.2	434	1.0		
570 *	-343	47	-207	300.1	64.6	403	16.2		
590 *	-374	83	-89	312.6	82.6	393	6.0		
610 *	-285	-68	-136	337.0	56.3	323	4.3		
630 *	-214	7	-172	303.2	55.4	275	8.7		
640 *	-263	2	-222	303.7	53.7	344	4.6		
650 *	-81	50	-25	222.9	72.9	98	3.0		
----	-124	-75	26	32.2	39.8	147	4.8		

INCLOR: dec = 317.5 inc = 66.7 int = 1010 mad = 8



Marias Pass 1

Specimens:

101 & 103 (avg), 102, 104, 105, 106, 107

In-situ: (Characteristic)

Dec=5.75°, Inc=49.34°

α_{95}=17.63°

k=19.78

δ_{63}=16.35°

(Secondary)

Dec=4.44°, Inc=68.95°

α_{95}=6.09°

k=158.84

δ_{63}=5.75°

Structurally corrected:

Dec=-77.23°, Inc=67.03°

α_{95}=12.51°

k=38.38

δ_{63}=11.72°

Dec=52.67°, Inc=54.13°

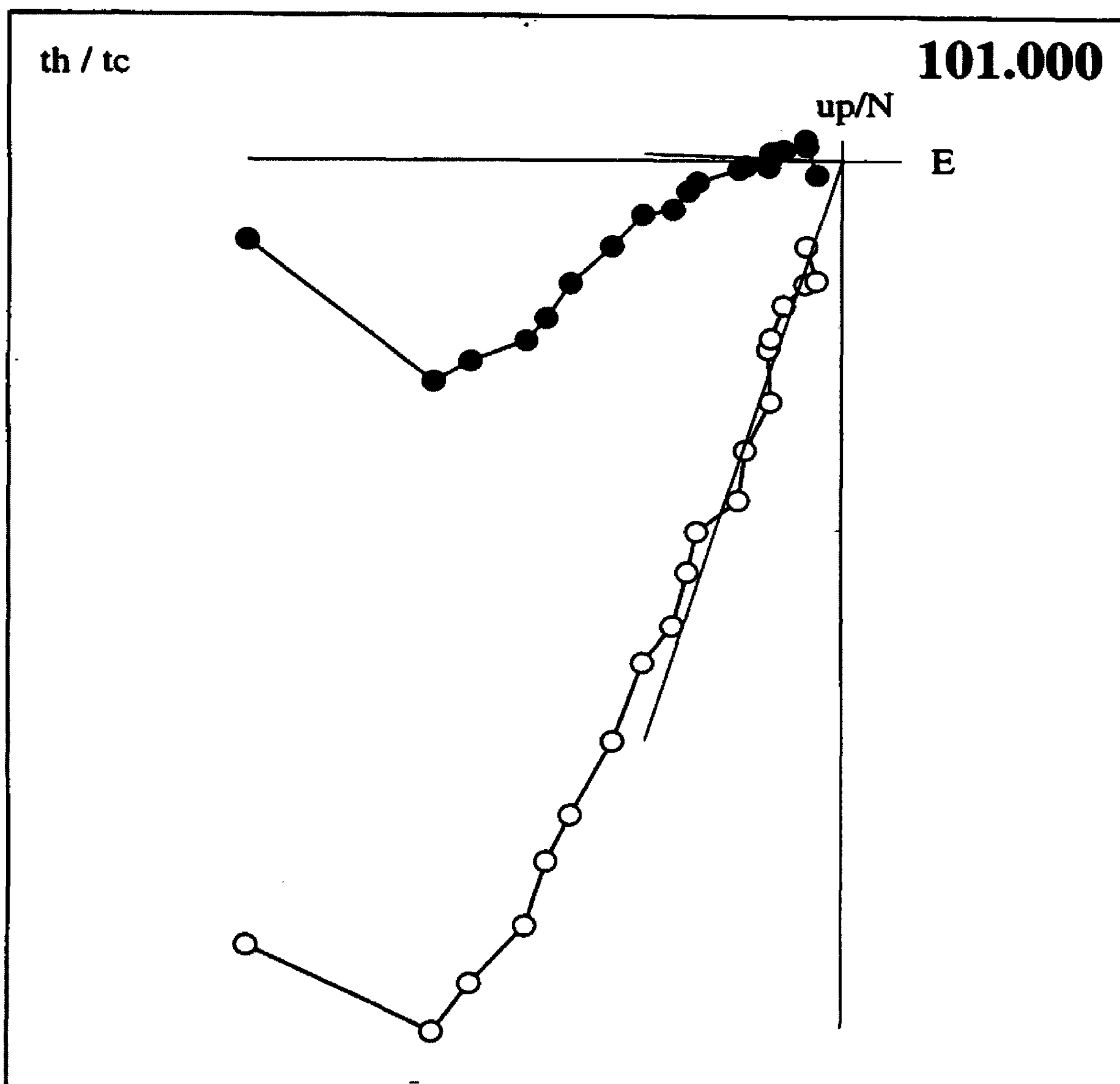
α_{95}=7.9°

k=94.77

δ_{63}=7.45°

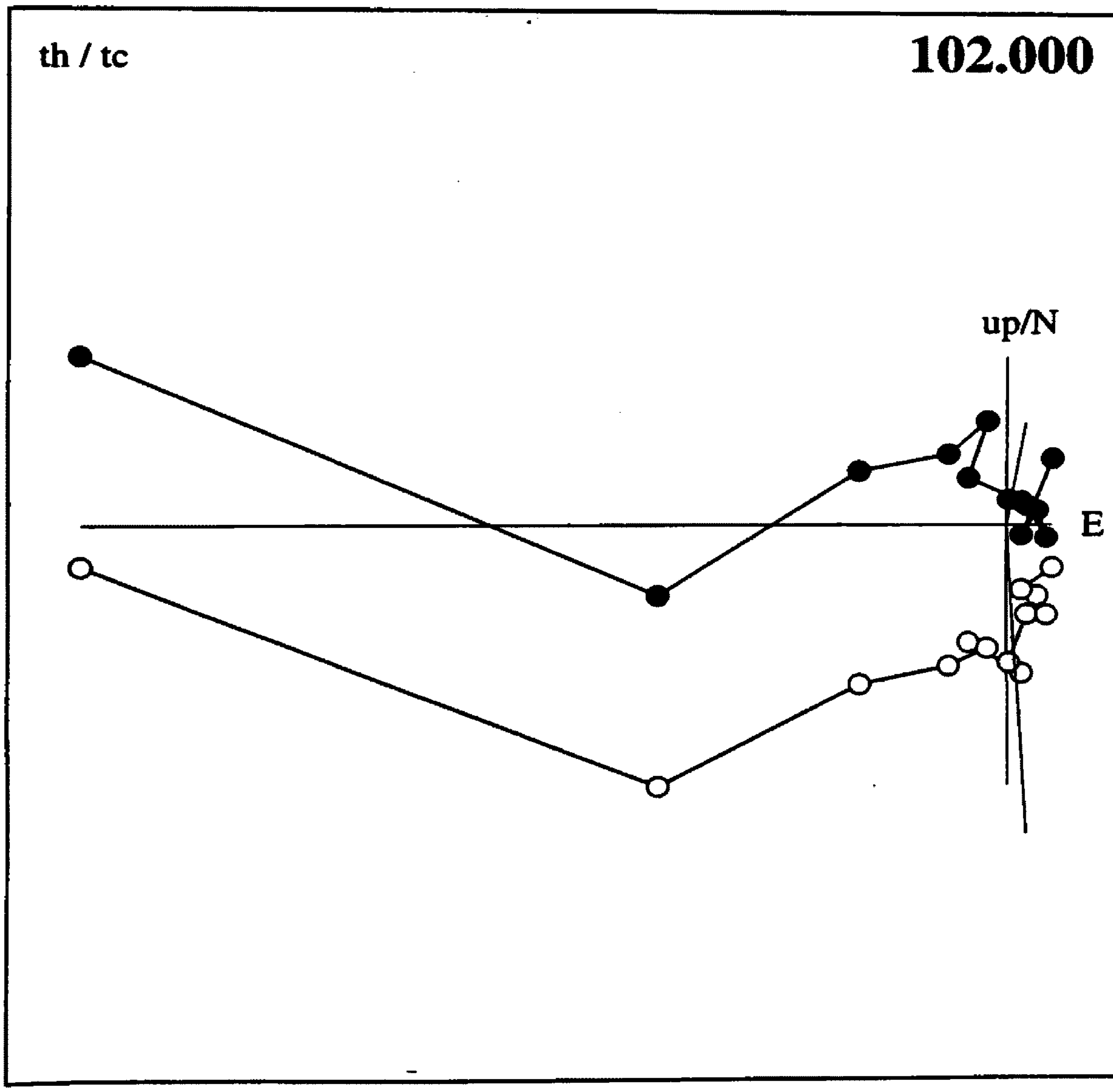
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-14799	25570	12552	261.6	55.1	32100	0.8		
2	-15785	28179	5107	239.2	63.5	32700	0.6		
4	-14448	26693	4609	239.2	64.4	30700	1.4		
6	-12741	24886	3685	238.0	66.0	28200	1.0		
8	-11578	22874	3678	239.7	66.0	25900	0.6		
10	-10051	21462	3789	243.7	67.2	24000	0.6		
14	-8105	19161	3518	247.7	68.8	21100	1.0		
18	-6483	16652	3452	253.4	69.4	18200	0.8		
22	-5699	15440	2832	252.4	70.9	16700	0.6		
28	-4783	13709	2867	257.7	70.7	14800	1.2		
32	-4237	12390	2845	260.7	70.2	13400	0.5		
40	-3062	11417	2069	264.7	74.5	12000	1.1		
50 *	-2701	9729	2033	266.7	73.1	10300	0.4		
60 *	-1890	8125	1578	272.3	75.0	8490	0.7		
70 *	-2026	6294	1543	264.7	70.3	6790	0.8		
80 *	-1555	5985	1761	277.0	69.8	6430	0.8		
90 *	-1149	4879	1527	281.6	69.5	5240	1.5		
100 *	-409	4181	1205	302.8	72.1	4370	1.1		
110 *	-1194	3978	240	238.6	77.2	4160	1.0		
120 *	-470	2901	1078	294.2	67.6	3130	2.2		

INCLOR: dec = 272.2 inc = 72.8 int = 10300 mad = 4.2



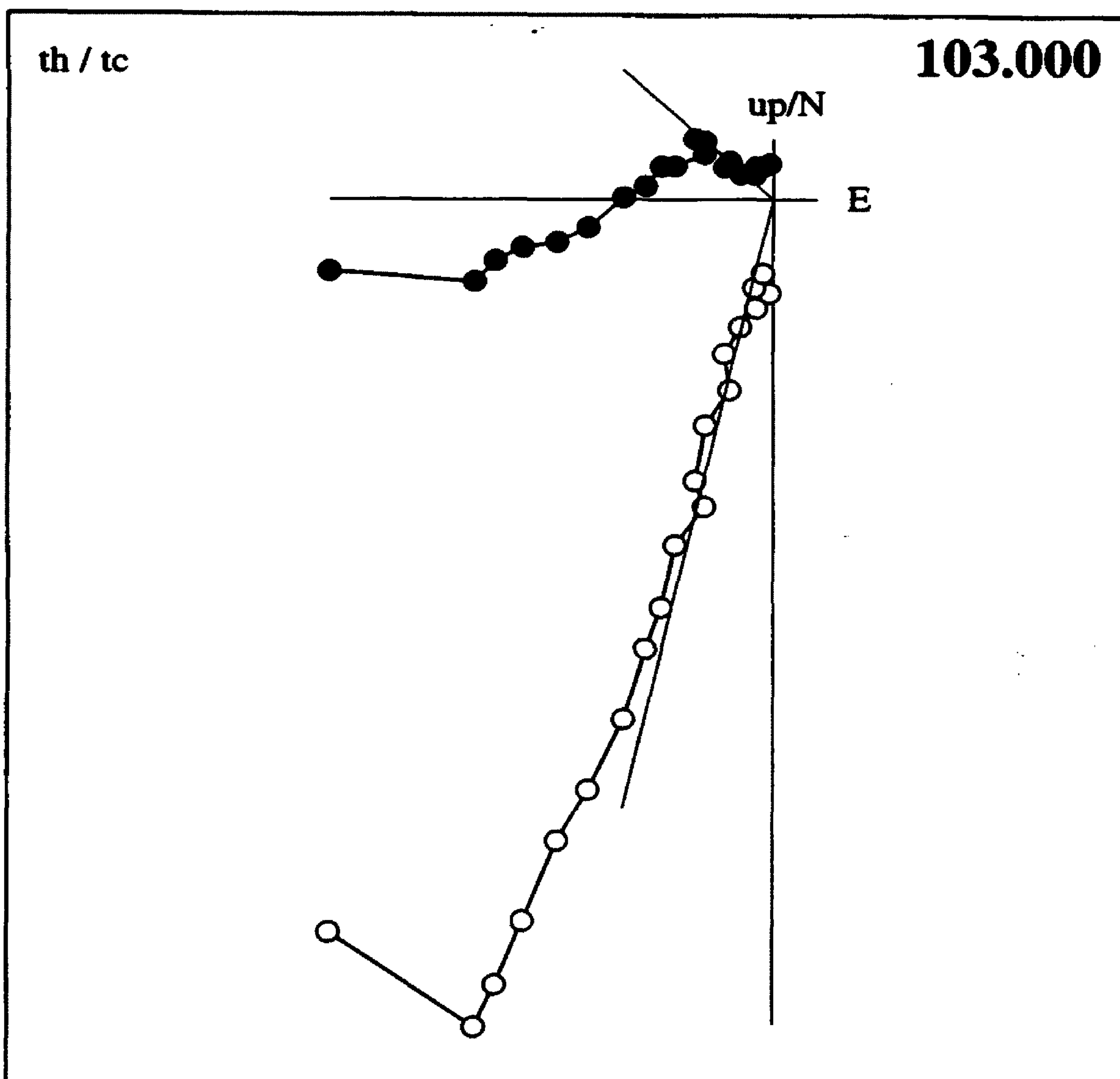
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-8567	5196	25287	281.5	2.7	27200	1.6		
100	-9315	7401	5945	257.4	38.6	13300	0.2		
200	-2243	5637	3245	292.0	47.6	6880	0.3		
250	-384	5149	1324	323.2	57.7	5330	0.3		
300 *	1198	4981	890	350.4	49.5	5200	0.2		
350 *	-504	4124	679	323.4	63.5	4210	0.2		
400 *	-689	4618	-1235	29.6	79.4	4830	0.1		
450 *	-713	4348	-810	5.1	79.5	4480	0.1		
500 *	-134	2828	-962	43.2	73.4	2990	0.3		
540 *	-707	2387	-1897	109.2	66.8	3130	0.2		
570 *	82	2206	-1152	62.1	65.9	2490	0.1		
585 *	-723	1745	-1028	126.0	75.4	2150	0.3		
605 *	1946	2010	-641	32.2	28.5	2870	0.3		
----	-2991	1646	-203	215.7	47.4	3420	0.5		

INCLOR: dec = 9.4 inc = 71.3 int = 5199 mad = 20.8



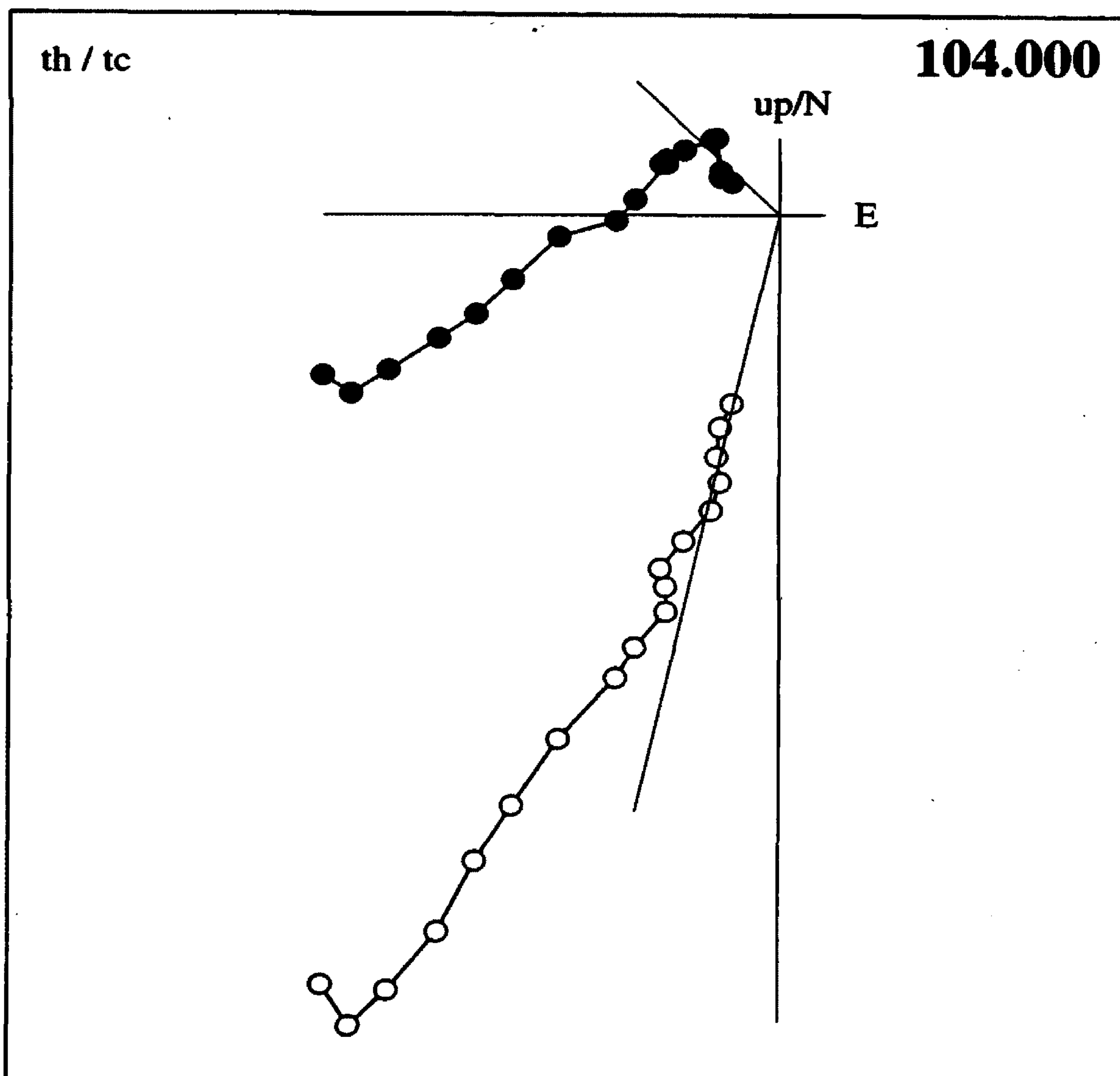
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-15234	27413	5836	259.9	60.8	31900	1.7		
2	-14023	30200	440	253.1	71.0	33300	0.4		
4	-12664	28837	533	256.4	71.6	31500	0.6		
6	-11295	26598	463	258.1	72.1	28900	0.9		
8	-9960	23691	207	257.8	72.6	25700	1.5		
10	-8575	21880	-56	260.5	73.9	23500	0.9		
14	-6468	19558	-26	270.9	75.4	20600	0.6		
18	-5175	17031	114	276.7	75.5	17800	0.3		
22	-3948	15709	303	288.1	75.4	16200	0.5		
28	-3249	13405	445	290.3	74.7	13800	0.9		
32 *	-2056	12025	86	306.1	75.9	12200	0.5		
40 *	-1505	11267	862	310.4	71.7	11400	1.1		
50 *	-997	9162	999	312.9	69.5	9270	0.9		
60 *	-959	7576	234	314.1	74.0	7640	1.0		
70 *	-956	6174	639	305.8	70.4	6280	0.5		
80 *	-708	5063	282	310.3	72.9	5120	0.5		
90 *	-54	4379	89	334.6	71.5	4380	1.0		
100 *	380	3818	-157	355.1	69.1	3840	0.5		
110 *	-189	3560	180	325.5	71.3	3570	1.0		
120 *	340	3096	184	344.4	65.1	3120	1.5		

INCLOR: dec = 313.2 inc = 72.8 int = 12199 mad = 4.1



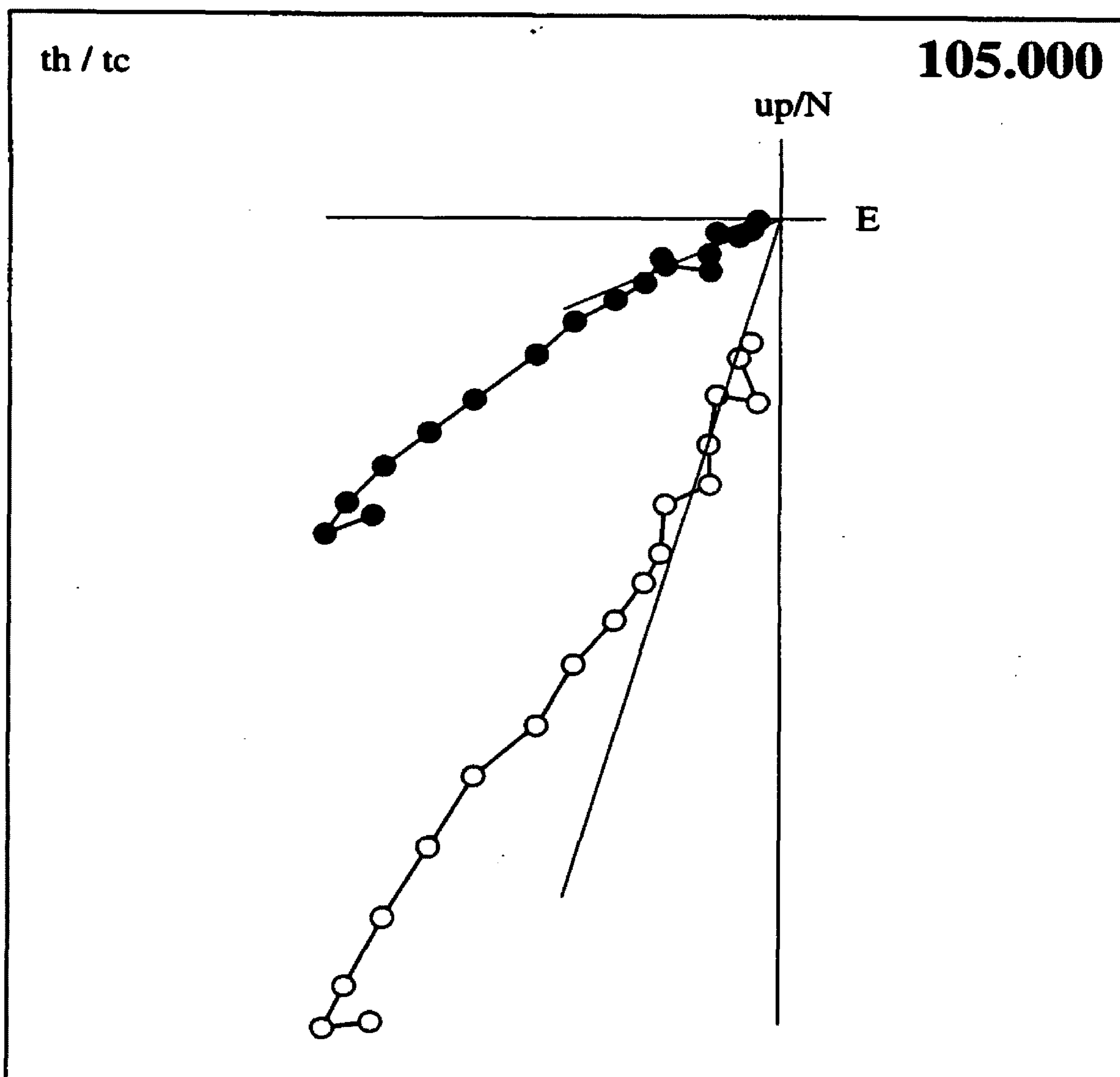
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-14491	15392	1595	248.8	59.9	21200	1.6		
2	-14968	15976	589	245.2	62.1	21900	1.7		
4	-13826	15402	346	246.3	63.4	20700	1.6		
6	-12199	14435	92	248.2	65.0	18900	1.3		
8	-10745	13174	102	250.2	65.6	17000	1.3		
10	-9225	12331	114	255.1	66.9	15400	1.6		
14	-7353	11322	77	263.7	68.9	13500	1.7		
18	-5924	10081	-422	267.8	72.2	11700	2.3		
22	-5053	9651	-386	276.7	73.0	10900	1.6		
28	-3722	9239	-425	296.6	73.9	9970	1.2		
32	-3419	8765	-196	298.4	72.6	9410	1.3		
40	-3394	8357	12	295.4	71.4	9020	1.1		
50	-2634	7870	-119	307.1	71.7	8300	1.1		
60 *	-1885	7272	-328	320.9	71.8	7520	1.3		
70 *	-2160	6297	-554	309.5	75.6	6680	1.7		
80 *	-1329	6148	-0	323.4	68.5	6290	1.4		
90 *	-1788	5071	-176	305.0	72.9	5380	1.1		
100 *	-1557	4480	-258	307.0	74.1	4750	1.2		

INCLOR: dec = 315.5 inc = 72.6 int = 7520 mad = 3.3



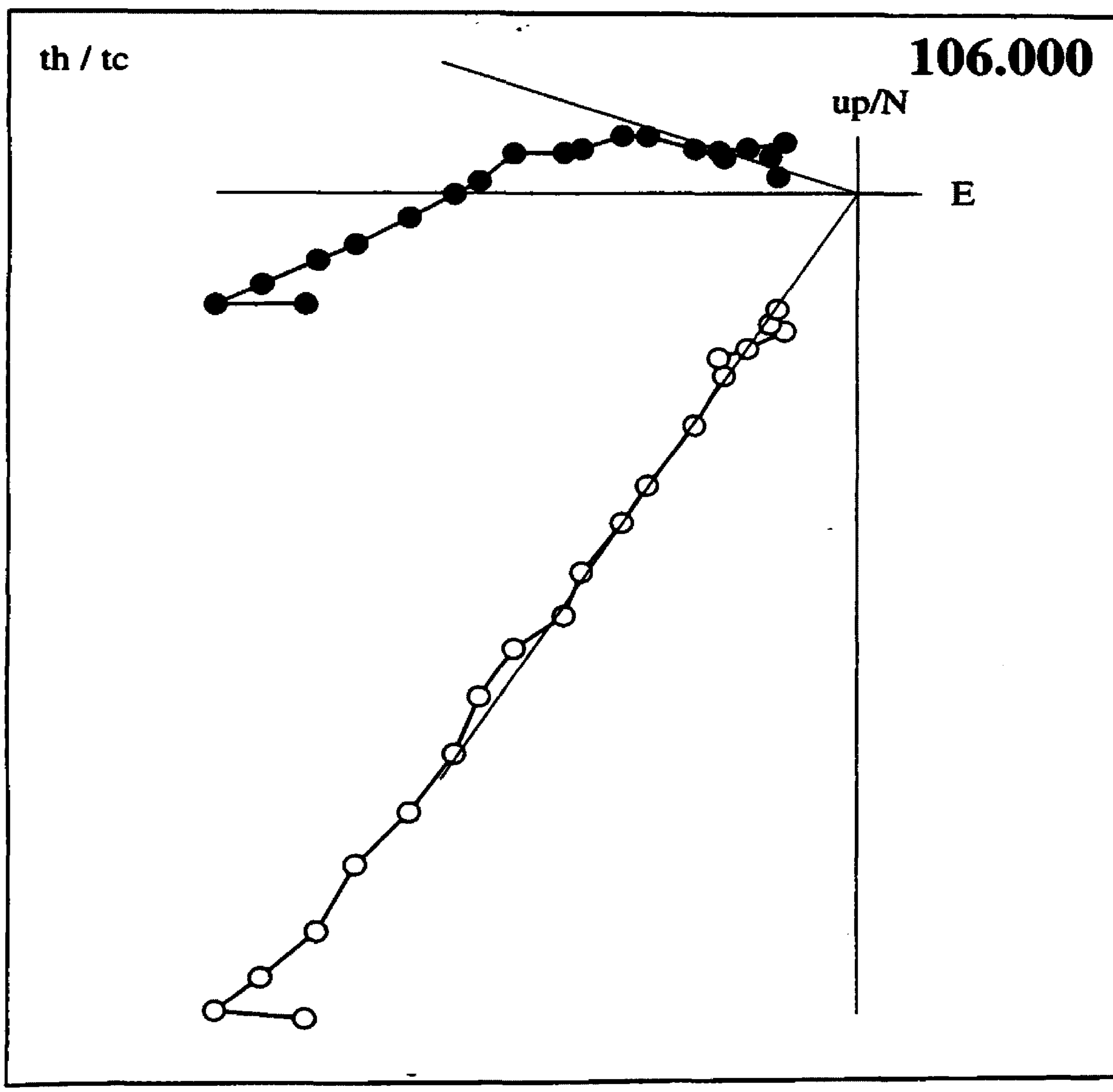
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-17037	19275	3003	231.1	59.4	25900	1.4		
2	-18153	19226	3705	232.5	57.2	26700	1.1		
4	-16909	18296	3793	234.1	57.6	25200	0.7		
6	-15183	16747	3665	235.4	57.9	22900	1.6		
8	-13401	15153	3326	236.0	58.6	20500	1.3		
10	-11637	13538	2985	236.8	59.3	18100	1.9		
14	-9446	12552	2456	238.4	62.9	15900	1.3		
18	-7810	11152	2251	241.2	64.5	13800	1.0		
22	-6495	10173	1783	241.6	67.1	12200	1.0		
28	-5476	9306	1492	242.8	69.2	10900	0.8		
34 *	-4522	8678	1562	250.2	71.0	9910	1.5		
42 *	-4338	7305	1400	246.1	68.2	8610	1.2		
50 *	-3712	6838	389	230.7	72.9	7790	1.6		
60 *	-3129	5824	719	241.3	71.9	6650	1.0		
70 *	-2242	4607	944	256.5	71.4	5210	1.3		
80 *	-1429	4961	272	265.2	83.6	5170	0.6		
90 *	-1813	3617	443	243.9	73.3	4070	2.5		
100 *	-1388	3231	312	246.5	76.8	3530	1.6		

INCLOR: dec = 245.4 inc = 72.3 int = 9910 mad = 4.4



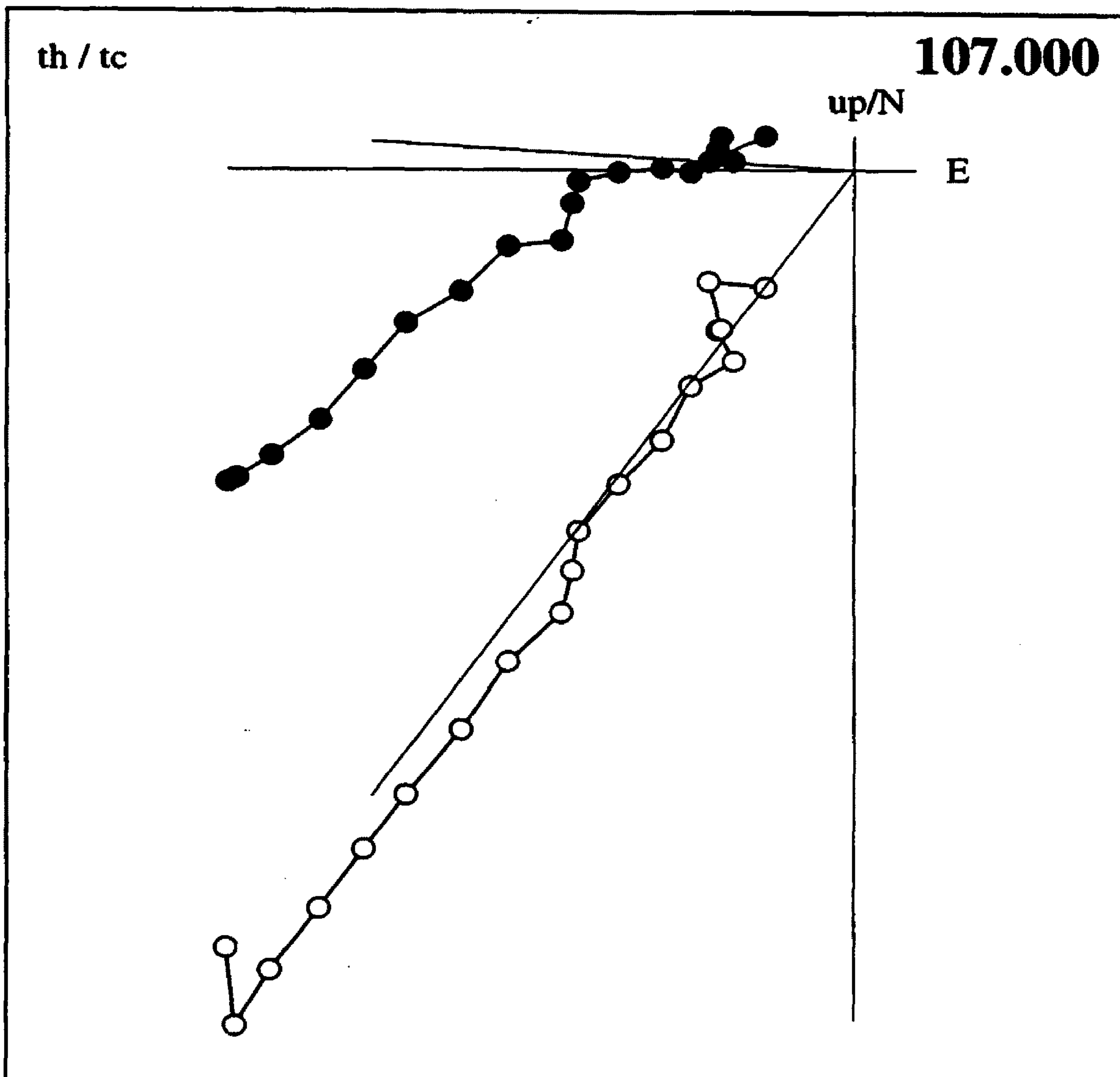
STEP		A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0		-14723	19802	8193	257.5	58.1	26000	0.9		
2		-15849	19435	10004	259.2	54.1	27000	1.0		
4		-14624	18775	9434	260.4	55.0	25600	1.4		
6		-13110	17833	8749	262.2	56.1	23800	0.8		
8		-11854	16292	8324	263.6	55.7	21800	0.8		
10		-10256	15202	7729	266.6	56.6	19900	0.3		
14		-8809	13916	7262	269.8	56.9	18000	0.3		
18		-7855	12556	7043	272.0	55.7	16400	0.6		
22		-6498	11534	6838	277.3	55.4	14900	0.9		
28		-5616	10774	5884	278.7	57.5	13500	1.4		
34		-5037	9694	5652	280.0	56.2	12300	0.8		
42		-3905	8558	5099	285.1	56.2	10700	0.6		
50	*	-3360	7624	4648	286.6	55.8	9540	0.3		
60	*	-2643	6062	3601	286.6	56.4	7530	0.4		
70	*	-2129	4762	2944	286.3	55.4	5990	0.6		
80	*	-1945	4316	3174	288.5	51.2	5700	1.2		
90	*	-1428	4138	2656	294.5	54.8	5120	1.4		
100	*	-698	3785	2006	307.9	58.8	4340	1.3		
120	*	-1158	3483	2103	295.0	56.3	4230	1.2		
130	*	-1416	2993	1674	282.8	57.4	3710	1.1		

INCLOR: dec = 289.1 inc = 55.7 int = 9540 mad = 3.6



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-24529	8843	-7742	241.2	50.1	27200	1.0		
2	-26463	7989	-7720	241.2	53.2	28700	1.3		
4	-24762	7514	-7349	241.5	53.0	26900	1.4		
6	-22761	6618	-6946	242.6	53.5	24700	1.4		
8	-20720	5453	-6869	245.8	54.3	22500	1.8		
10	-18849	4340	-6791	249.4	55.2	20500	1.8		
14	-16761	3459	-6192	251.3	56.0	18200	1.8		
18	-14539	2432	-5960	256.4	56.7	15900	1.4		
22	-13049	1957	-4970	255.2	58.2	14100	1.2		
28	-11662	1400	-5333	262.6	57.2	12900	1.5		
32	-10465	1200	-5536	267.4	55.3	11900	1.5		
40 *	-9039	827	-4868	269.5	55.8	10300	1.6		
50 *	-7725	473	-4037	270.7	57.2	8720	1.7		
60 *	-6241	610	-3373	269.2	55.5	7120	1.4		
70 *	-5348	-25	-2675	274.4	60.2	5980	1.5		
80 *	-4513	228	-3153	279.3	51.9	5510	1.3		
90 *	-4379	-75	-3293	285.4	51.8	5480	1.6		
100 *	-3361	1007	-3082	273.7	39.9	4670	1.2		
110 *	-3104	-386	-2412	293.1	53.1	3950	1.7		

INCLOR: dec = 273.7 inc = 55.0 int = 10300 mad = 5.7



Marias Pass 2

Specimens:

108 & 109 (avg), 110, 111, 112, 113, 114

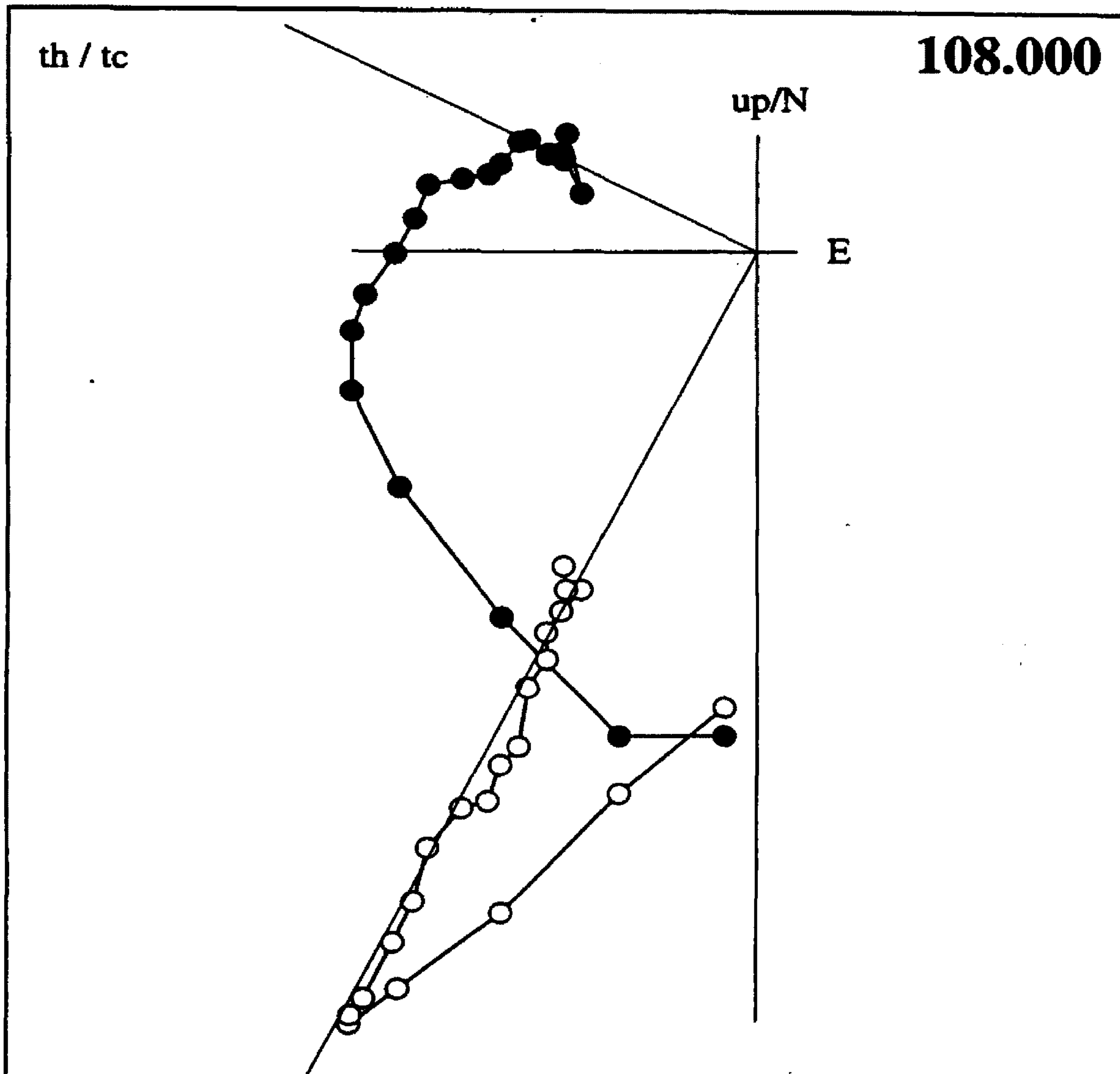
In-situ: (Characteristic)	(Secondary)
Dec=2.26°, Inc=51.82°	Dec=9.01°, Inc=73.17°
α_{95}=8.81°	α_{95}=13.35°
k=109.62	k=86.35
δ_{63}=6.71°	δ_{63}=7.12°

Structurally corrected:

Dec=-78.87°, Inc=66.66°	Dec=45.96°, Inc=53.75°
α_{95}=8.91°	α_{95}=14.75°
k=107.36	k=70.93
δ_{63}=6.78°	δ_{63}=7.86°

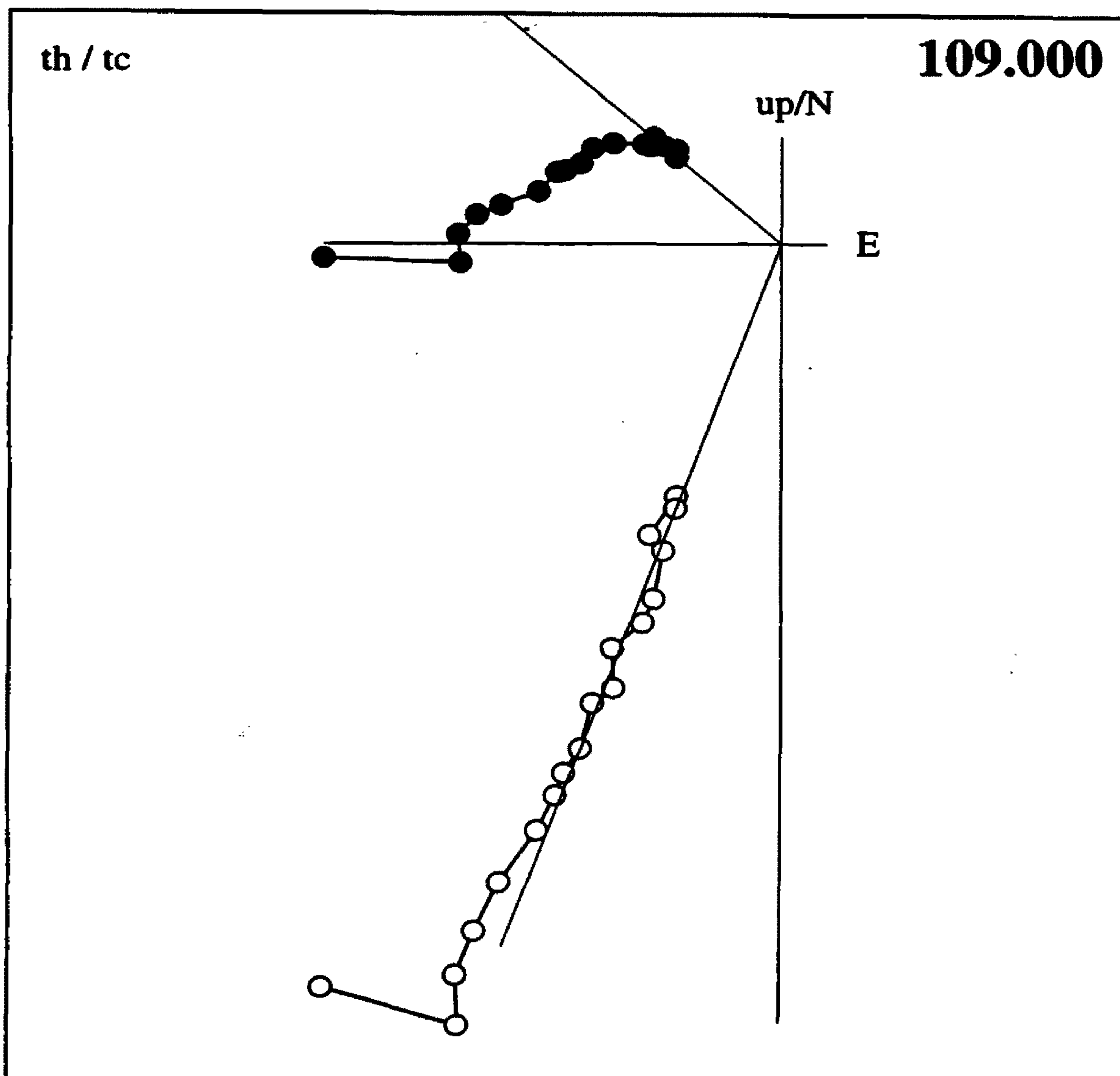
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-13247	8955	-6060	183.5	43.2	17100	1.0		
0	-15092	10663	-3968	194.5	47.3	18900	1.2		
2	-14846	13698	81	212.3	56.7	20200	1.1		
4	-13902	15775	3978	233.9	61.4	21400	1.0		
6	-12731	16929	6305	249.2	63.0	22100	0.8		
8	-11440	16994	7157	257.7	63.7	21700	1.0		
10	-10414	16784	7421	263.1	64.3	21100	0.5		
14	-8859	15711	7411	269.6	64.5	19500	0.5		
18	-7656	14949	7514	276.0	64.3	18400	0.3		
22	-6468	13836	7691	282.4	62.8	17100	0.3		
28	-5683	13039	7107	285.0	63.5	15900	0.6		
32	-5206	12986	6673	287.5	65.0	15500	0.8		
40	-4623	12195	6563	290.5	64.1	14600	1.1		
50	-3829	11908	6508	296.7	63.9	14100	0.5		
60 *	-3298	10511	6319	298.2	61.7	12700	0.2		
70 *	-3167	9819	5727	297.1	62.4	11800	0.7		
80 *	-3023	9142	5721	296.9	60.7	11200	0.2		
90 *	-2678	8688	5450	299.0	60.6	10600	0.9		
100 *	-3124	8039	4461	290.0	63.4	9710	0.8		
110 *	-2104	8256	5609	304.0	58.3	10200	1.1		
120 *	-2524	7541	5252	297.3	58.0	9530	0.3		

INCLOR: dec = 297.8 inc = 60.9 int = 12699 mad = 2.4



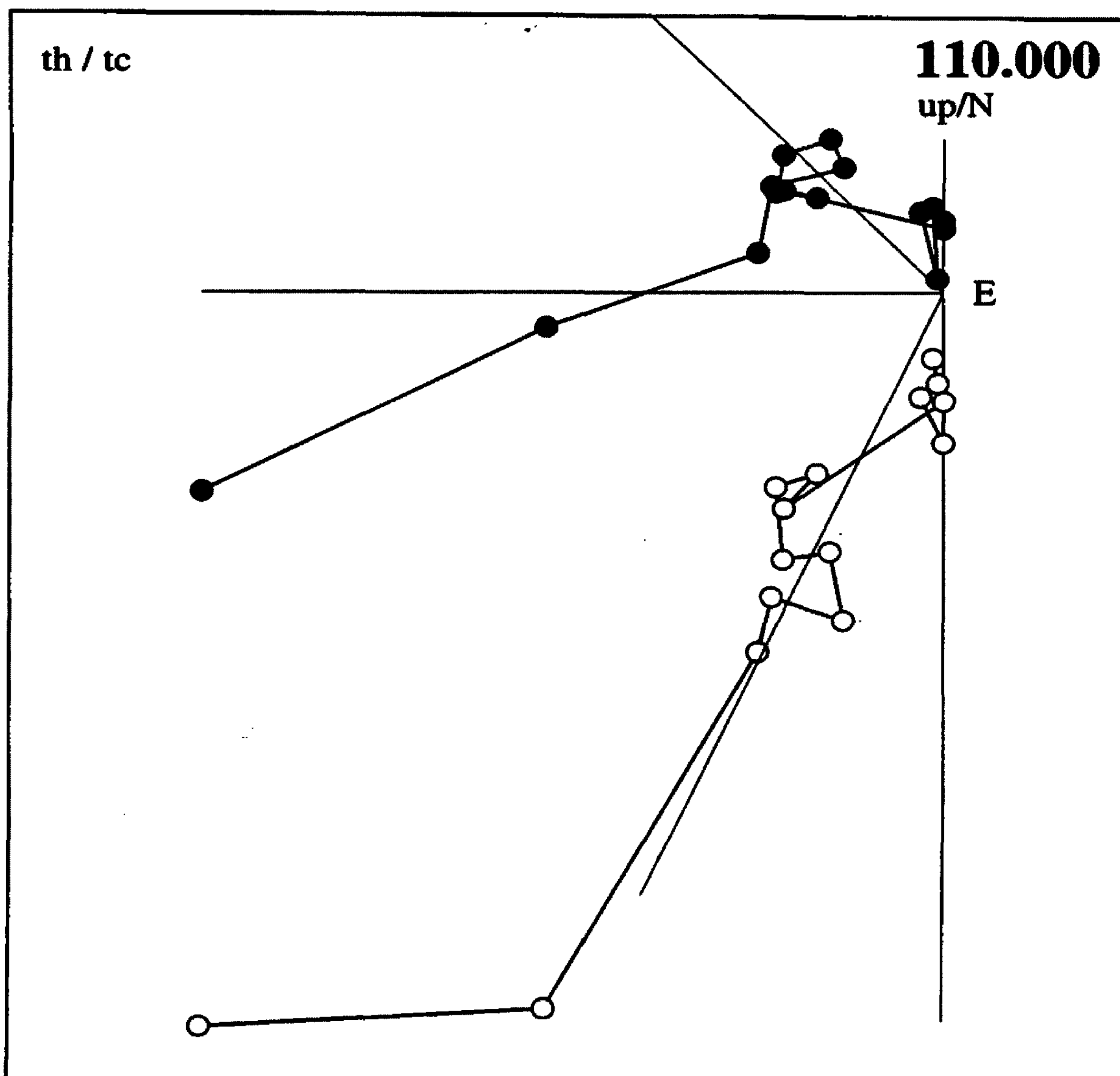
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-11758	20639	10324	268.1	60.8	25900	1.3		
4	-10149	22176	7098	266.3	69.4	25400	0.7		
6	-9153	20835	7623	271.8	68.1	24000	0.4		
8	-8122	19701	7528	276.0	67.9	22600	0.5		
10	-7215	18390	7123	278.6	68.0	21000	1.2		
14	-5989	17042	6506	283.4	68.8	19200	0.6		
18	-5010	16174	6396	289.4	68.5	18100	0.6		
20	-4713	15549	6227	290.5	68.3	17400	0.8		
26	-4150	14923	5970	293.8	68.5	16600	0.4		
32	-3315	13696	5961	299.1	66.9	15300	0.5		
40	-2793	13328	5536	303.3	67.7	14700	0.6		
50	-2530	12145	5572	303.4	65.7	13600	0.9		
60	-1964	11469	4833	308.3	67.2	12600	0.5		
75 *	-1465	10827	4717	312.6	66.1	11900	0.5		
90 *	-1227	9365	4352	312.6	64.7	10400	0.5		
105 *	-1366	8863	4647	309.1	62.3	10100	1.1		
120 *	-792	7745	3994	314.6	62.1	8750	0.8		
130 *	-1074	8076	3872	312.0	64.1	9020	0.6		

INCLOR: dec = 312.1 inc = 64.1 int = 11900 mad = 1.7



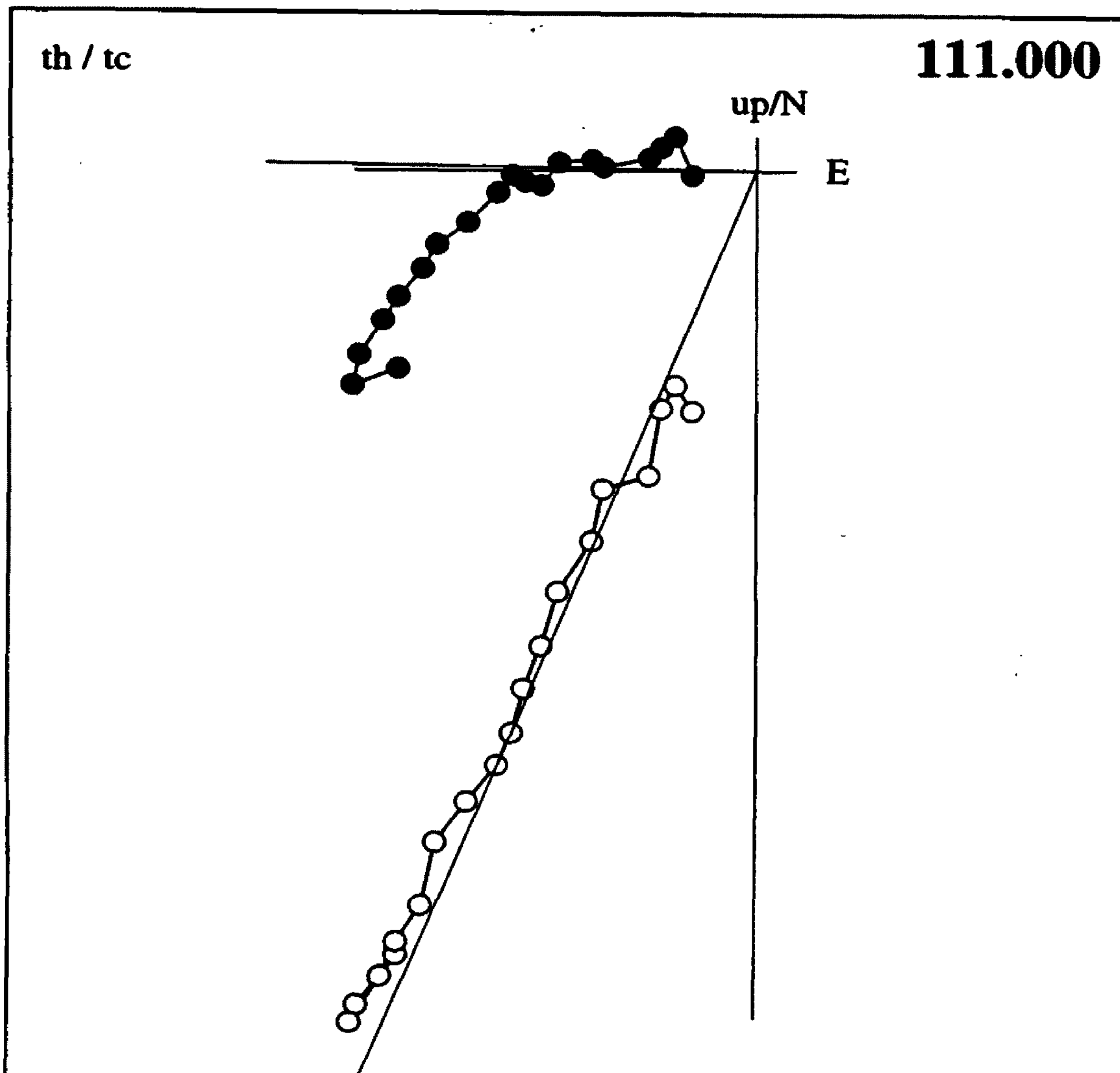
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-20447	15619	11044	253.5	46.2	28000	1.8		
100	-12787	17334	5372	264.5	63.0	22200	0.1		
200	-5016	9424	3040	283.1	64.3	11100	0.1		
250 *	-2791	8826	3755	304.1	58.3	9990	0.1		
300 *	-1790	9685	2239	324.1	64.9	10100	0.1		
350 *	-569	8255	3195	326.2	54.5	8870	0.1		
400 *	-1566	8246	4029	313.2	53.3	9310	0.2		
450 *	-1714	5975	4070	303.3	47.1	7430	0.1		
500 *	-1204	5591	3151	309.7	50.6	6530	0.1		
540 *	-1805	6535	3816	305.1	50.8	7780	0.2		
570 *	297	3489	244	0.6	59.6	3510	0.3		
585 *	23	4647	162	0.1	64.5	4650	0.1		
605 *	449	3548	987	345.5	51.5	3710	0.2		
630 *	-719	2454	-114	338.7	80.8	2560	0.2		
650 *	1106	2624	944	353.5	37.3	3000	0.2		

INCLOR: dec = 316.1 inc = 56.7 int = 9990 mad = 10.5



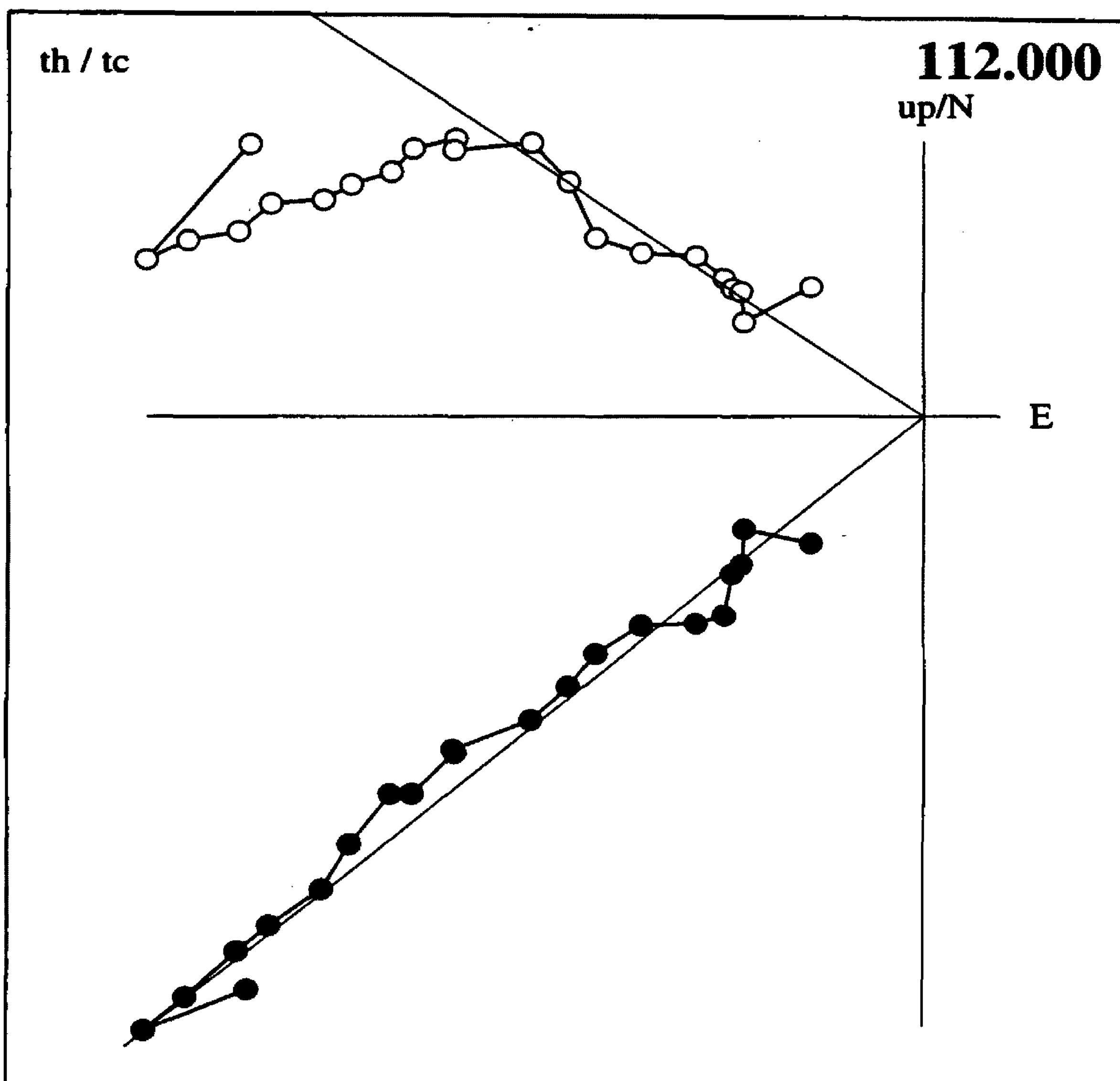
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-12686	11792	-1664	238.7	64.1	17400	2.1		
2	-13864	12896	-1580	239.6	63.6	19000	1.5		
4	-13156	12926	-1438	243.0	64.2	18500	1.2		
6	-12192	12748	-1467	246.2	65.3	17700	1.0		
8	-11400	12403	-1350	248.8	65.7	16900	1.0		
10	-10460	12032	-1348	252.1	66.6	16000	0.6		
14	-9404	11259	-947	255.8	66.0	14700	1.1		
18	-8470	10718	-1031	258.9	67.1	13700	1.0		
22	-7471	10333	-1117	264.7	68.4	12800	1.5		
28 *	-6801	9956	-1020	268.8	68.5	12100	1.0		
32 *	-6421	9138	-842	267.1	67.8	11200	0.9		
40 *	-5978	8354	-755	265.8	67.6	10300	0.9		
50 *	-5005	7680	-493	272.6	66.9	9180	0.6		
60 *	-4293	6749	-578	274.0	68.0	8020	1.1		
70 *	-3844	5794	-314	271.6	66.4	6960	0.9		
80 *	-3297	5444	-912	277.1	72.1	6430	1.5		
90 *	-2426	4459	-491	284.8	69.4	5100	0.9		
100 *	-1938	4143	-486	294.8	69.3	4600	1.0		
110 *	-2685	4014	-1089	265.9	76.3	4950	0.8		

INCLOR: dec = 270.9 inc = 68.5 int = 12100 mad = 2.9



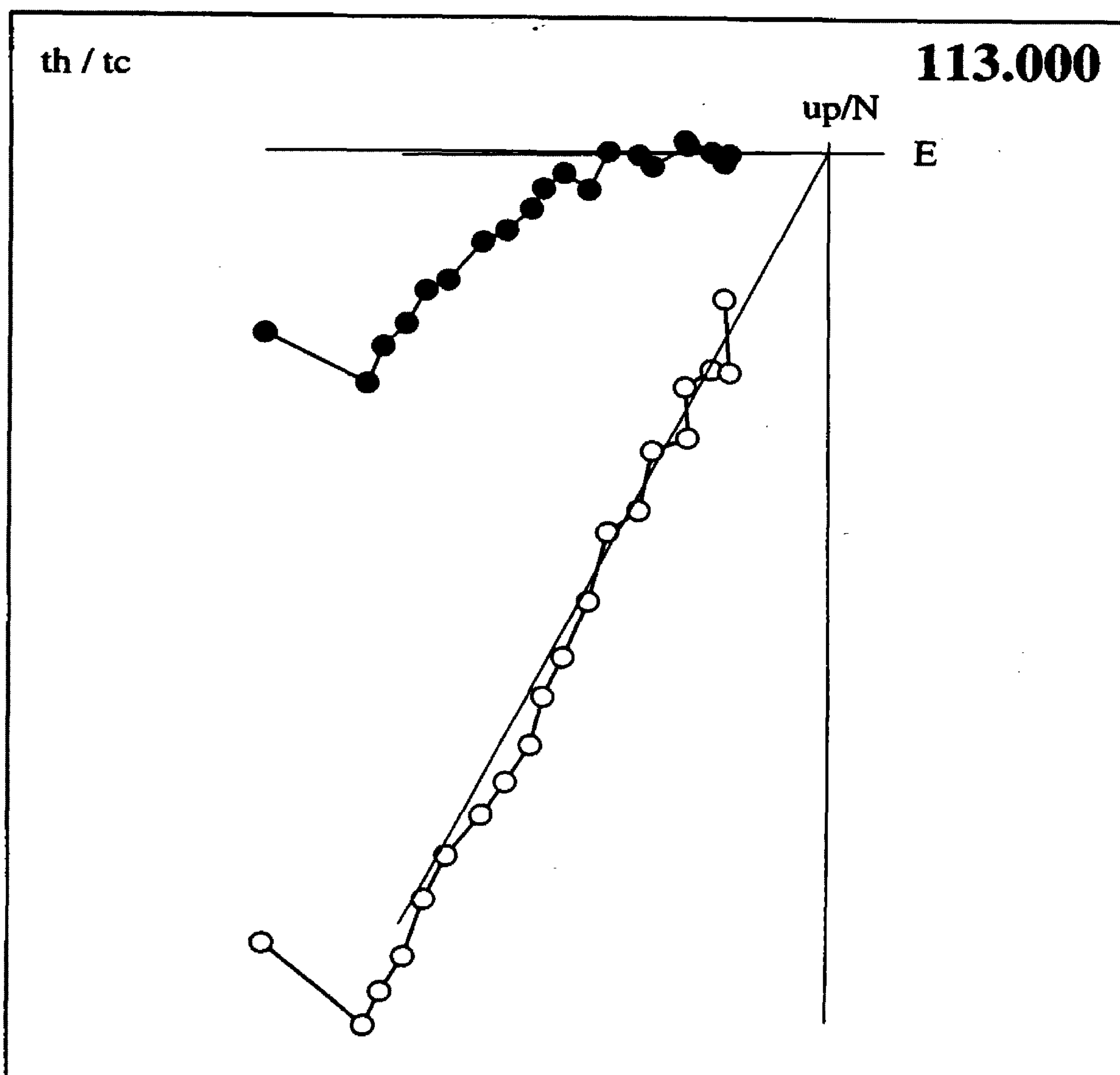
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-10596	-6095	12242	226.9	-18.0	17300	0.9		
2	-12946	-4271	12654	228.9	-9.5	18600	1.1		
4	-11979	-4424	12256	229.0	-11.3	17700	0.6		
6	-10863	-4353	11632	229.3	-12.8	16500	0.6		
8	-10011	-4647	11445	229.4	-15.2	15900	1.1		
10	-9077	-4624	10736	229.2	-16.7	14800	0.5		
14	-8054	-4510	10526	230.7	-19.0	14000	0.4		
18	-6923	-4378	10095	232.1	-21.7	13000	0.5		
22	-6573	-4843	9988	230.9	-24.1	12900	0.9		
28	-5567	-4794	9488	231.7	-27.1	12000	0.6		
32	-5639	-4590	9420	232.1	-26.1	11900	0.4		
40 *	-4637	-4856	8331	229.7	-30.2	10700	1.1		
50 *	-4245	-4161	7424	230.1	-29.1	9510	1.1		
60 *	-4079	-3161	6513	231.6	-25.1	8310	0.2		
70 *	-3499	-2927	5699	230.9	-26.3	7300	0.4		
80 *	-3177	-3218	4822	225.0	-28.7	6610	1.0		
90 *	-3097	-2987	4167	222.2	-27.1	5990	1.1		
100 *	-2482	-2425	4006	227.7	-28.6	5300.	1.1		
110 *	-2305	-2332	3854	228.1	-29.3	5060	1.3		
120 *	-2001	-1494	3562	235.3	-25.5	4350	1.4		
130 *	-1491	-2604	2838	218.8	-38.4	4130	0.6		

INCLOR: dec = 228.9 inc = -28.5 int = 10700 mad = 3.9



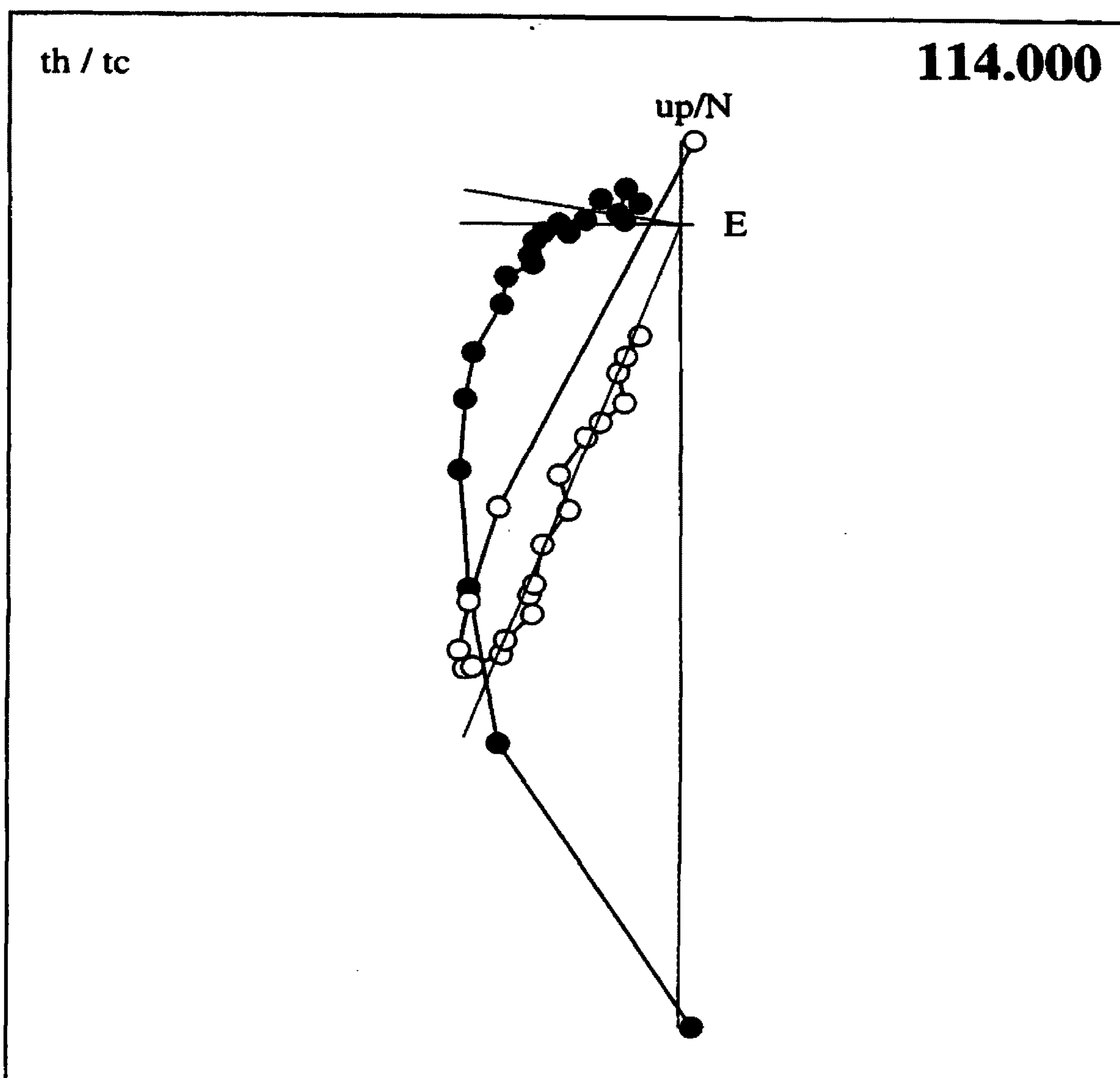
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-12289	14834	2299	250.5	55.6	19400	2.0		
2	-13173	15312	-226	241.0	61.3	20200	0.7		
4	-12172	14977	-81	244.2	61.9	19300	0.9		
6	-11379	14459	-80	245.8	62.4	18400	0.7		
8	-10268	13673	185	249.2	62.4	17100	1.1		
10	-9623	12906	204	249.7	62.4	16100	0.9		
14	-8453	12391	102	254.0	63.8	15000	1.4		
18	-7879	11814	14	254.9	64.3	14200	0.9		
22	-7087	11254	-27	258.0	65.1	13300	0.6		
28	-6318	10550	246	261.9	64.4	12300	0.6		
32	-5633	9907	272	264.9	64.5	11400	0.3		
40	-5377	8664	242	260.1	63.9	10200	0.7		
50 •	-4084	7725	612	270.1	62.4	8760	0.8		
60 •	-3798	7161	273	269.0	64.4	8110	1.3		
70 •	-3486	5947	479	264.8	61.8	6910	0.8		
80 •	-2797	5734	74	273.0	66.0	6380	0.7		
90 •	-2375	4908	554	274.9	60.9	5480	0.7		
100 •	-2291	4372	207	269.8	64.0	4940	0.5		
110 •	-2240	4300	-126	268.2	67.8	4850	0.9		
120 •	-1900	2978	518	263.2	57.0	3570	1.1		

INCLOR: dec = 269.4 inc = 63.4 int = 8760 mad = 2.6



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-19967	-16745	-4226	179.1	-5.9	26400	0.7		
2	-19988	-655	-2011	197.6	27.5	20100	0.9		
4	-17595	4801	-1497	207.7	42.5	18300	1.7		
6	-15260	8280	-1153	219.1	53.4	17400	0.8		
8	-13593	9983	-1091	228.0	59.4	16900	0.6		
10	-12226	10734	-1000	235.6	62.8	16300	0.9		
14	-10462	11087	-1310	243.6	67.2	15300	0.9		
18	-9467	11195	-1071	251.6	68.2	14700	1.4		
22	-8440	10577	-1359	253.7	70.3	13600	0.9		
28	-7966	10226	-987	257.1	69.3	13000	0.8		
32	-7365	10186	-876	263.0	69.7	12600	0.7		
40	-6486	9238	-532	266.1	68.7	11300	0.4		
50	-5682	8142	-785	265.2	70.5	9960	0.8		
60 *	-5033	7461	-10	270.3	66.3	9000	0.9		
70 *	-4096	6351	-204	272.7	68.0	7560	1.4		
80 *	-3138	6229	-273	289.2	68.8	6980	1.1		
90 *	-3167	5163	-803	274.2	74.1	6110	0.7		
100 *	-2613	4537	-201	280.4	68.9	5240-	0.5		
110 *	-1630	4504	-34	305.1	65.3	4790	0.6		
120 *	-1569	3595	-236	298.5	69.3	3930	0.9		

INCLOR: dec = 279.7 inc = 68.8 int = 9000 mad = 4.8



Marias Pass 3

Specimens:

115, 117, 118, 119, 120

In-situ:

Dec=12.80°, Inc=75.15°

α_{95}=15.91°

k=24.07

δ_{63}=14.81°

Structurally corrected:

Dec=37.70°, Inc=46.92°

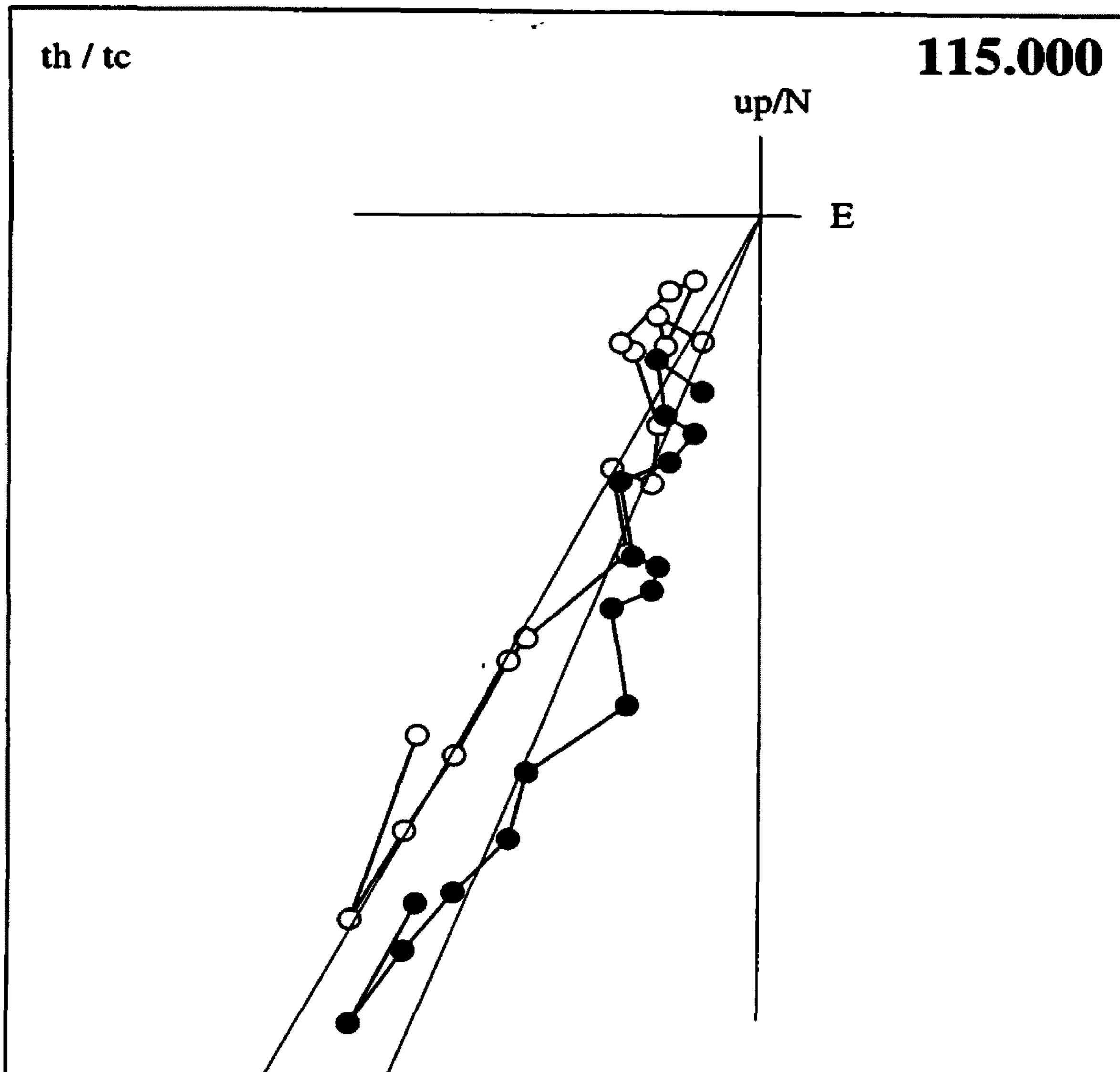
α_{95}=15.96°

k=23.94

δ_{63}=14.85°

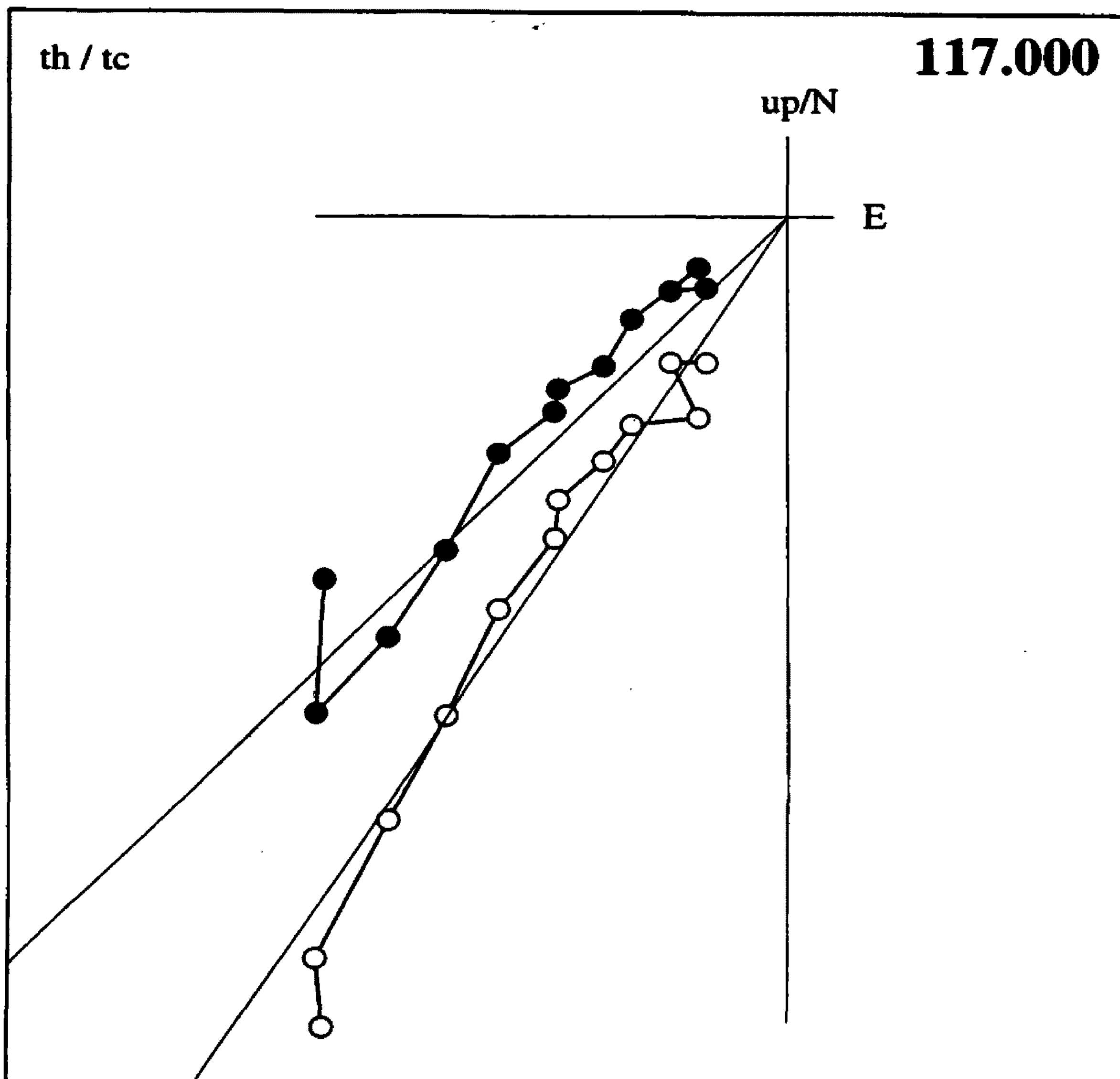
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-2584	429	-238	204.3	34.6	2630	0.5		
2 *	-3146	697	-423	204.6	38.4	3250	1.6		
4 *	-2819	565	-377	203.6	37.5	2900	1.6		
6 *	-2549	439	-349	202.2	36.4	2610	1.8		
8 *	-2265	264	-300	200.0	33.9	2300	1.5		
10 *	-2059	296	-290	200.8	35.4	2100	2.0		
14 *	-1711	103	-353	193.8	33.8	1750	2.0		
18 *	-1387	99	-165	198.8	31.4	1400	1.5		
22 *	-1328	108	-273	194.6	34.8	1360	1.2		
28 *	-1196	16	-184	194.7	30.0	1210	1.4		
32 *	-1107	-87	-6	198.6	20.7	1110	1.5		
40 *	-925	25	45	205.4	23.4	926	2.7		
50 *	-772	-112	33	198.4	16.1	781	2.4		
60 *	-667	-121	0	195.1	15.9	678	2.1		
70 *	-725	78	-47	203.2	31.1	731	2.1		
80 *	-561	111	30	212.9	30.3	573	1.5		
90 *	-630	59	-114	196.4	34.5	643	0.5		
----	-456	-154	-85	181.6	15.1	489	5.7		

INCLOR: dec = 201.2 inc = 34.9 int = 3250 mad = 5.4



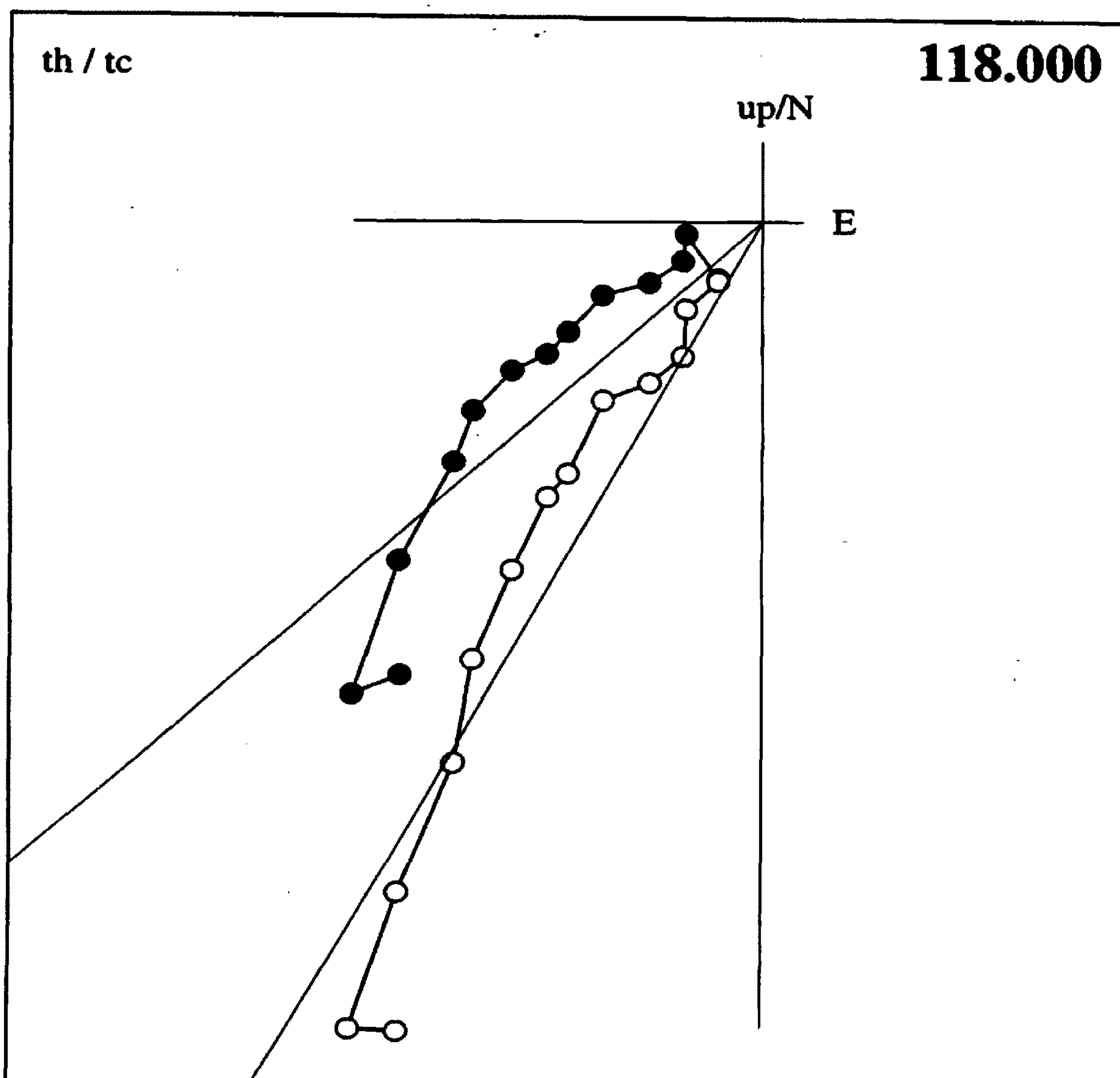
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-5182	16	-1445	229.2	55.5	5380	1.2		
2 *	-5295	662	-950	220.8	48.5	5420	2.3		
6 *	-4386	639	-779	220.8	47.3	4500	2.0		
10 *	-3609	519	-736	222.9	47.6	3720	2.7		
16 *	-2786	386	-745	227.9	48.0	2910	1.9		
22 *	-2284	307	-595	227.4	48.2	2380	2.3		
28 *	-2041	347	-616	230.5	46.4	2160	1.7		
36 *	-1748	259	-475	228.3	47.5	1830	1.5		
44 *	-1413	140	-484	234.1	50.1	1500	2.0		
52	-1147	-198	-396	237.9	64.6	1230	1.4		
60	-1009	131	-362	235.1	48.4	1080	1.5		
70	-956	14	-235	226.1	54.9	985	1.5		

INCLOR: dec = 223.4 inc = 47.9 int = 5419 mad = 2.5



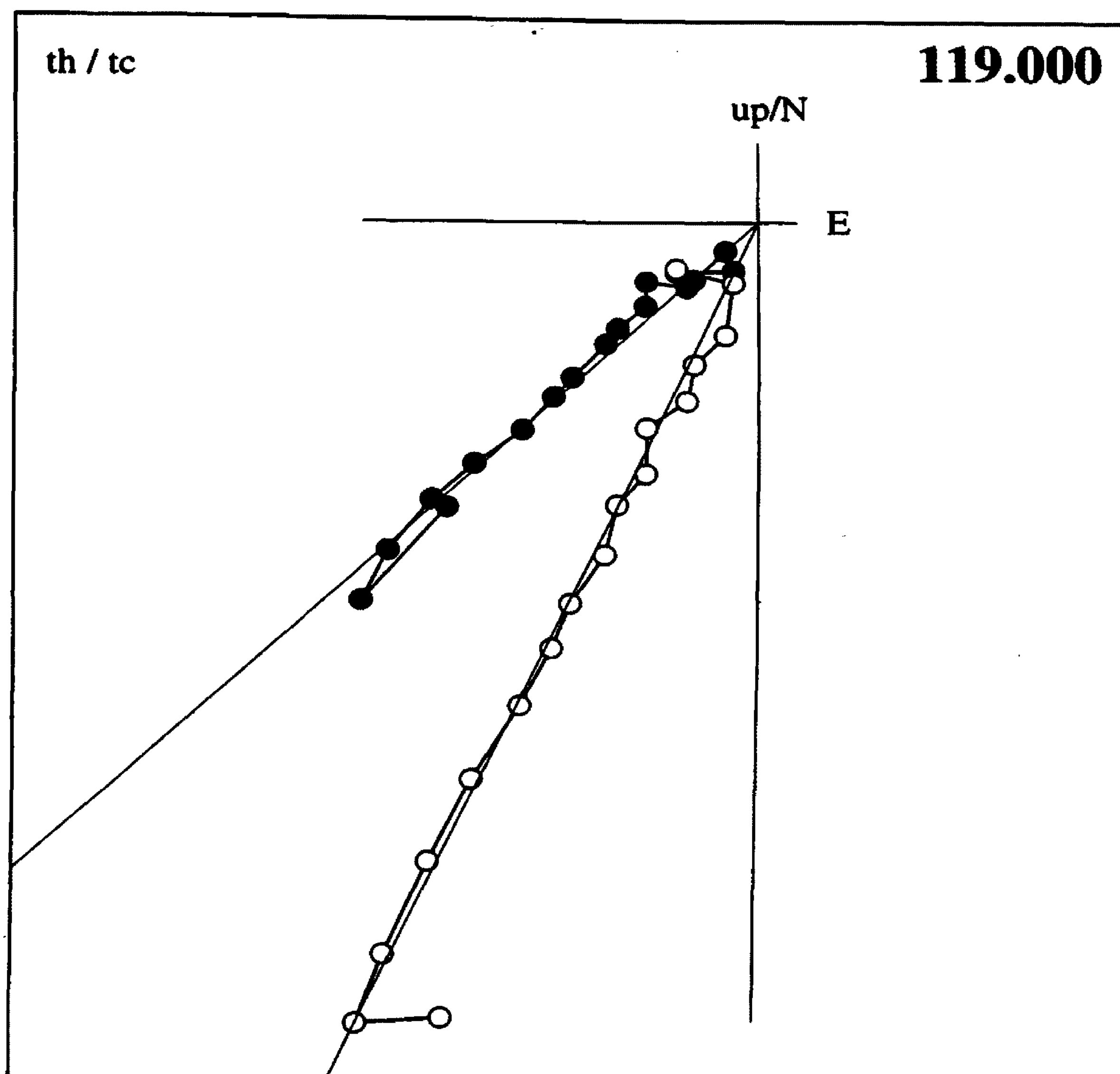
STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-5617	1019	-602	216.0	55.2	5740	1.5		
2 *	-5689	1244	-737	218.2	53.3	5870	1.5		
8 *	-4621	887	-894	224.2	54.7	4790	1.2		
14 *	-3671	622	-900	229.3	55.7	3830	1.6		
20 *	-2996	603	-916	234.2	53.5	3190	2.5		
28 *	-2398	533	-821	236.7	52.0	2590	1.5		
36 *	-1947	535	-677	235.9	49.4	2130	1.2		
44 *	-1755	436	-644	238.0	50.5	1920	2.4		
52 *	-1251	355	-570	243.3	47.8	1420	1.4		
62 *	-1092	205	-396	239.3	53.5	1180	3.1		
72 *	-872	78	-308	241.5	58.5	928	0.3		
87	-555	72	-352	260.0	51.0	661	0.5		
102	-486	226	-41	215.4	40.5	538	1.5		

INCLOR: dec = 226.6 inc = 53.8 int = 5869 mad = 4.8



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-7793	-1056	-1016	224.6	63.3	7930	2.6		
2 *	-8419	-199	-1155	223.5	57.0	8500	1.5		
6 *	-7643	-262	-1194	225.6	57.4	7740	1.4		
10 *	-6652	-278	-1113	226.9	57.7	6750	1.5		
14 *	-5805	-244	-967	226.8	57.8	5890	1.5		
18 *	-5004	-257	-776	225.8	58.4	5070	1.7		
22 *	-4375	-292	-700	226.7	59.2	4440	1.4		
30 *	-3918	-253	-653	227.3	59.0	3980	1.4		
38 *	-3334	-342	-570	228.6	61.1	3400	1.5		
46 *	-2869	-227	-548	230.2	59.5	2930	1.0		
54 *	-2480	-317	-449	230.5	62.3	2540	1.2		
64 *	-2034	-241	-547	239.5	60.2	2120	1.2		
74 *	-1771	-223	-234	224.6	62.8	1800	1.0		
84 *	-1449	-118	-215	225.7	60.1	1470	0.5		
94 *	-1040	-265	-124	225.9	69.9	1080	0.1		
104	-721	87	40	205.2	48.8	727	1.8		
114	-748	384	-333	235.7	27.5	905	2.6		

INCLOR: dec = 226.1 inc = 58.2 int = 8500 mad = 1.8



STEP	A	B	C	DECtc	INCtc	INTENS	ERR	DATE	TIME
0	-9182	-1232	-6814	271.1	55.7	11500	0.8		
2	-8761	-269	-4428	251.7	56.8	9820	1.8		
4	-8381	25	-3362	242.1	56.8	9030	1.4		
6	-7786	283	-2684	236.4	55.6	8240	1.4		
8	-7260	349	-2043	230.5	55.4	7550	1.6		
10	-6825	434	-1832	229.2	54.6	7080	1.5		
12	-6441	392	-1480	225.6	54.8	6620	1.9		
14 *	-6123	536	-1381	225.1	53.3	6300	2.0		
16 *	-5751	415	-1249	224.4	54.2	5900	2.4		
18 *	-5530	356	-1245	225.1	54.6	5680	2.0		
20 *	-5176	509	-1254	226.6	52.7	5350	1.5		
24 *	-4993	418	-1146	225.5	53.5	5140	2.3		
28 *	-4584	494	-1057	225.6	52.2	4730	1.6		
32 *	-4268	378	-910	224.0	53.3	4380	2.0		
36 *	-4019	388	-769	222.0	52.8	4110	1.6		
40 *	-3759	399	-728	222.3	52.2	3850	2.5		
46 *	-3435	396	-657	222.1	51.7	3520	1.9		
52 *	-3198	345	-737	225.6	52.2	3300	2.0		
58 *	-2696	433	-782	230.3	49.3	2840	2.5		
64 *	-2619	389	-474	221.3	49.9	2690	1.4		
70 *	-2210	403	-654	230.6	48.1	2340	1.9		
78 *	-2167	442	-191	214.1	46.2	2220	1.8		
86 *	-1838	248	-242	217.0	50.3	1870	1.2		
94 *	-1270	102	-200	218.8	53.6	1290	1.5		
102 *	-1572	144	-65	208.3	51.8	1580	0.7		
112 *	-701	324	-63	216.6	33.1	775	1.7		
122 *	-645	-91	-274	251.2	47.7	751	1.0		
----	-687	73	-249	236.8	51.8	734	0.8		

INCLOR: dec = 224.5 inc = 52.8 int = 6300 mad = 2.6