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Geology of rocks along the East Branch Pleasant River, White Cap Range, Central Maine

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Previous Work

Espenshade (1972) mapped the Moxie and Katahdin plutons and adjacent metasedimentary rocks between Greenville and Jo-Mary Mountain. Recent reconnaissance mapping by Mark Loiselle and Gary Boone in portions of the White Cap Range and adjacent areas was done in preparation for the new geologic map of Maine.

Acknowledgements

Dan Cochran and Lyman Feero, Woodlands Division, Great Northern Paper Company, kindly provided air photographs and maps of the field area. Mark Loiselle, Maine Geological Survey, introduced me to the geology of the region. Bill Betters and Dana Weinberg, Salem State, assisted in the field. I would like to extend special gratitude to Gary Boone who took the time to visit the section with me and offered invaluable advice and discussion.

Purpose of fieldtrip

The intent of this trip is as follows;

1. to introduce briefly the effects of the Acadian Orogeny along the western flank of the Kearsarge-Central Maine Synclinorium within and surrounding the White Cap Range;

2. to introduce the stratigraphy and structure of the area as demonstrated by a series of excellent exposures along the East Branch Pleasant River;

3. to study the sedimentary features and discuss modes of deposition, directions of sediment transport, tectonic and sedimentary environments of the Carrabassett(?) and Seboomook(?) in the area.

The majority of this trip will be devoted to studying and discussing the lithology and sedimentary features of the above formations which are exposed in several large outcrops along the East Branch Pleasant River.

Effects of the Acadian Orogeny

The rocks within this area were exposed to regional deformation and two metamorphic events during the Acadian Orogeny. Chlorite grade regional metamorphism and associated regional folding affected the region first, resulting in the development of upright to slighly overturned folds which strike and plunge northeast. In pelitic rocks folding was accompanied by the development of nearly vertical penetrative cleavage. This is best observed in rocks of the Carrabassett Formation which comprises a prominant slate belt extending from the White Cap Range westward to Greenville, and southwest through Monson.

In regions adjacent to the Katahdin and Moxie plutons contact metamorphism produced granofels and destroyed nearly all vestige of slatey cleavage. In the study area rocks have been prograded to hornblende-hornfels facies by the intrusion of the Katahdin pluton, exposed one kilometer (.6 mile) north of Stop 2. The extent of the contact aureole, greater than 5 kilometers, implies that the closest contact with the pluton may not be to the north but at depth. The contact metamorphism of this area is strikingly similar to that of the Skiddaw Aureole, Cumbria, England (Rastall, 1910).

Pelitic beds and laminae have developed medium- to coarse-grained granoblastic and porphyroblastic textures in which cordierite, andalusite and biotite can often be recognized in hand specimen. Feldspathic and quartz-rich psammitic beds have undergone less change, are generally finer grained, and lighter in color. The resultant contrast between the metapelitic and metapsammitic beds and laminae enhances the visability of laminations and grading of beds, which in regions of pervasive cleavage, are difficult to distinguish.

Stratified Rocks

Three units are exposed along the East Branch Pleasant River. These rocks can be tenatively correlated with the Madrid(Moench, 1971), Carrabassett (Boone, 1973), and Seboomook(Boucot, 1961 and Boone, 1973) formations along strike to the southwest on the basis of resemblence and stratigraphic relationships. However, lacking paleontologic evidence, correlation at this point is speculative.

Madrid(?) Formation

The Madrid(?) along the East Branch Pleasant River is exposed in the core of an anticline and along the Mud Gauntlet Fault (here named) where it is brought up against the Seboomook(?). Only the upper portion of the formation is exposed in both locations.

Where exposed, in this area, the formation is a gray to purple-gray biotite metasandstone. The unit is predominantly massive and bedding is at best faint. Bedding is observed near the contact with the overlying Carrabassett(?) where faint, slightly contorted laminations are visable. One of the distinguishing characteristics of this unit are the numerous greenish-gray calcsilicate pods scattered throughout it.

Carrabassett(?) Formation

The Carrabassett(?) has an estimated thickness of 1800 meters (5900 feet) and consist of alternating units of massive metapelite with thin- to medium-bedded, generally poorly-graded metapelite and metasandstone, with rare lenses and blocks (olistoliths?) of light-gray, quartz-rich metasandstone one to two meters thick. The sandy portions of graded beds are generally less than 20 percent but locally may be as high as 40 to 50 percent. On the fresh surface the metapelite appears dark purple and glittery. Porphyroblasts of andalusite and cordierite are commonly visable.

The weathered surface is characteristically pitted and rough because of the removal of cordierite and the resistance of andalusite, which stands out as small chalky-white knots or layers.

Mass-gravity transport appears to have played a major role in the deposition of the formation in this area. Flow(?) and incoherent slumping affected nearly 80 percent of this unit. At the moment is is difficult to state conclusively whether some of the massive metapelites were indeed massive, or simply well-bedded, predominantly pelitic units which became homogenized by subaqueous flow.

Mass-gravity transport within the Carrabassett(?) of this section is evidenced by;

1. folding and shearing of bedding which does not conform to the the local structure;

2. undisturbed beds which are sandwiched between deformed beds of the same composition;

3. angular to subrounded blocks of bedded metapelite, metasandstone and massive metapelite are incorporated in a deformed matrix of the same or slightly different composition.

The following features, preserved in the metasediments provide insight into the source and directions of sediment transport during deposition.

1. **Slump Folds**

   a. Converging direction of folds.
   Most of the slump folds appear chaotic (fig. 4) and no sense of motion has been conclusively determined. At Stop 3B the fold hinges are exposed and give the appearance of a southward directed slump.

   b. Orientation of fold hinges
   Hinges of the slump folds (Stop 3B) are roughly parallel to the local tectonic trend. This may be coincidence or suggest mass-movement into a tectonically controlled basin or trough.

2. **Minor faulting of beds**

   Small gravity faults suggest slumping of sediment toward the south (Stop 4).

3. **Current structures**

   Apparent current directions, determined from ripple foresets, indicate transport toward the ENE, parallel to the local tectonic trend.

4. **Dip of the formation**

Undisturbed beds within the formation have southerly dips 20°-30° steeper than those of the overlying Seboomook(?). This may suggest tilting prior to deposition of the Seboomook and/or a steeper south-facing depositional slope.

The lower contact of the Carrabassett(?) and the underlying Madrid(?) is not exposed but can be inferred to within a few meters. The fine laminae in the Madrid(?) are contorted near the contact which is overlain by a massive metapelite unit of the Carrabasset(?).

The upper contact is well exposed at Gauntlet Falls. The slumped beds of Carrabassett(?) are highly contorted and nearly vertical. The uneven surface formed by the Carrabassett(?) is draped by a well-bedded, undisturbed, homoclinal sequence of Seboomook(?) metasediments.

Although the upper and lower contacts are discordant they do not necessarily imply an interruption in sedimentation and may not be true unconformities.

The Carrabassett(?) along the East Branch Pleasant River differs slightly from that at its type locality in the Carrabassett Valley(Boone, 1973). The quartzwacke member does not occur in this section, however the quartzwacke occurs as discontinuous lenses and is commonly missing from local section. In the type locality the massive metapelite underlies a thinly-bedded member. In this section the massive metapelite and thinly-bedded units alternate and appear to have no fixed stratigraphic position. The upper, discontinuous, variegated, rusty-weathering calcsilicate member (Hildreth Formation of Osberg and others, 1968) is missing along the East Branch Pleasant River. However, a unit strikingly similar to this member is exposed 8 kilometers(5 miles) to the northwest, along the south end of Upper Jo-Mary Lake (see mile 20.3 of road log).

Seboomook(?) Formation

Between Gauntlet and Mud Gauntlet Falls there is 550 meters (1800 feet) of nearly continuous outcrop. A thickness of 300 meters(985 feet) of Seboomook(?) is exposed along this section and can be studied in detail from the basal contact at Gauntlet Falls, to Mud Gauntlet Falls where the section is truncated by a fault along which Madrid(?) is brought up(fig. 3).

The base of the Seboomook (Fig. 5) is characterized by a sequence of thin-bedded turbidites consisting of thin ripple trains of metasandstone overlain by thick metapelite (CE divisions, Bouma, 1963). There is no visable grading from the metasandstone to the metapelite or within the metapelite. The thin-bedded unit changes rapidly to thick-bedded turbidites (AB divisions, Bouma, 1963) and back to thin-bedded over a relatively short stratigraphic thickness.

This rapid change in sequences has been seen at other exposures in the area and may represent levee or basin-plain deposits overlain by those of a prograding suprafan lobe (Walker, 1976).

Superficially these rocks resemble the Seboomook at its type locality northwest across strike at Seboomook Dam(Boucot, 1961). However, these rocks lack the well-graded, monotonous, cyclic bedding characteristic of the type section. Nevertheless, the Seboomook(?) along the East Branch Pleasant River closely resembles turbidites, mapped as Seboomook(Boone, 1973) on Little Poplar Mt., along strike to the southwest. Sediment transport within the Seboomook(?) in this area is principally from the south (figs. 5 and 6) and not from the east as noted in the Seboomook to the northwest (Hall and others, 1972, 1976).

Local Structure

The section of the East Branch Pleasant River which will be visited extends from the core of an anticline, exposing Madrid(?), 2.4 kilometers upstream from Gauntlet Falls, to the axis of a faulted syncline at Mud Gauntlet Falls. The Madrid(?) and slices of the Carrabassett(?) have been juxtaposed against the Seboomook(?) along the fault. The total thickness covered will be approximately 2250 meters(7380 feet). This figure also represents the approximate amount of stratigraphic displacement which has occurred along the Mud Gauntlet Fault. This fault connects with a major thrust which extends southwest through Wyman Lake, near Bingham, southwest toward the Maine-New Hampshire border (Boone, personal communication). To the Northeast the fault extends for 16 kilometers (10 miles) where it is truncated by the Katahdin Pluton.

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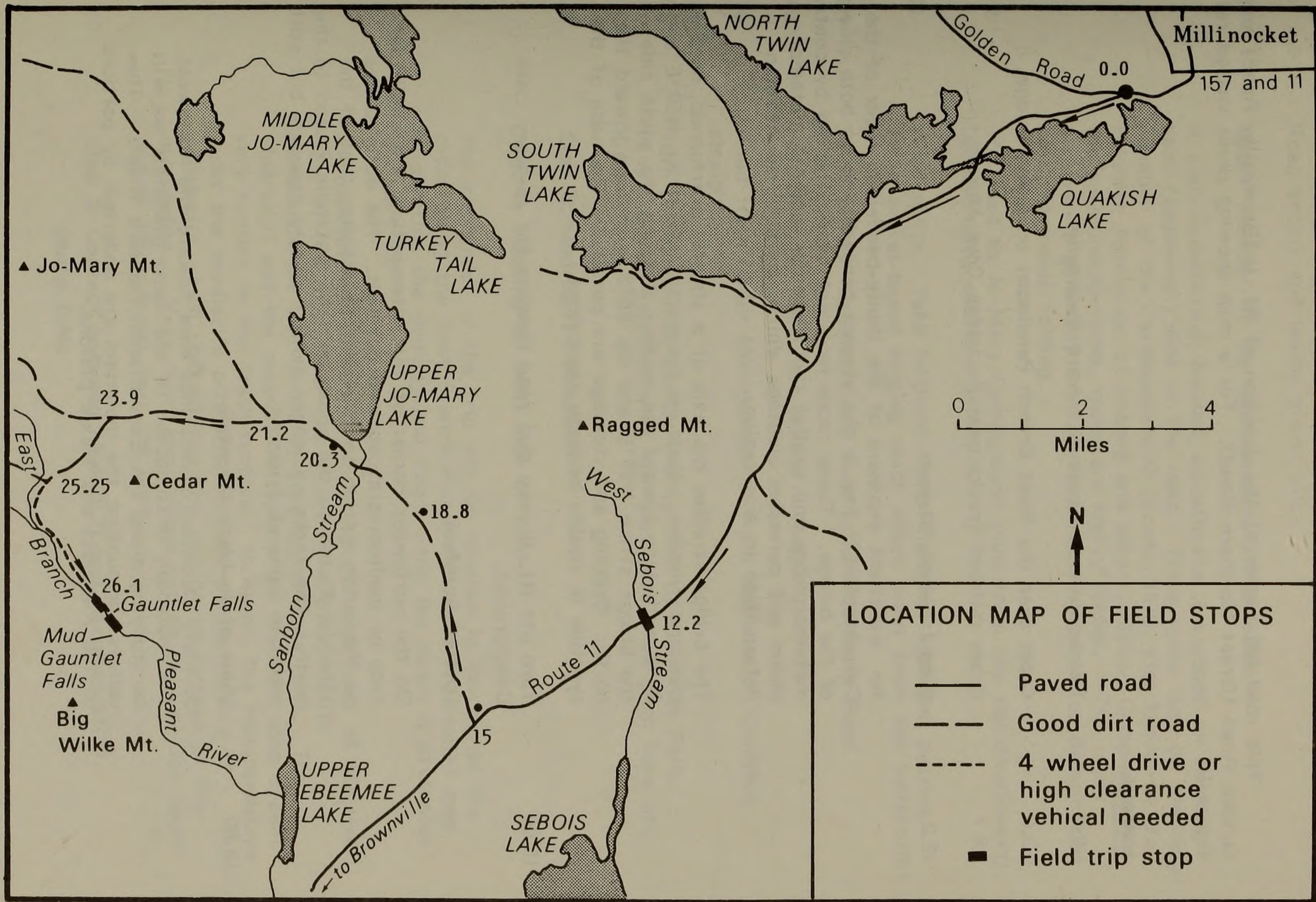


Figure I. Location map of areas visited. Important road-log mileages are shown above. Road log begins at the junction of the Golden Road and Route II (mileage 0.0 on map).

Road Log

This road log begins at the Junction of Rt. II (Brownville Road) and the Golden Road (Great Northern Road). For a map showing areas visited refer to figure I.

Mileage

0.0 Head south on Route II toward Brownville.

3.0 Cross over the West Branch Penobscot on green bridge.

6.7 Cross railroad tracks near Partridge Cove Marina.

12.2 **Stop I: Sebois Stream**

An excellent exposure of the thinly-bedded member of the Carrabassett(?) lies in the stream beneath and on both sides of the bridge. These rocks have not been affected by contact metamorphism and exhibit the low-grade regional metamorphism and pervasive cleavage which characterize Acadian deformation in this region.

The bridge stradles the axis of a slightly overturned, northeast-plunging syncline. Beds on the north side strike N50°E and dip 84°S with tops toward the south. Beds on the south side of the bridge strike N55°E and dip 89°S with tops toward the north. Bedding and cleavage are parallel. The nose of the syncline is visable beneath the bridge.

15.00 Turn off Rt. II onto dirt road heading for Jo-Mary Lake Campground.

Spotted hornfels

On the northwest corner of this intersection is a small outcrop of medium-gray spotted hornfels. The outcrop lies on the outer margin to two contact areoles; that of the Schoodic Pluton to the south and the Katahdin Pluton to the north. The rocks no longer exhibit slately cleavage but still maintain signs of foliation.

18.80 **View of Jo-Mary Mountain**

Jo-Mary Mountain comes into view toward the northwest. The mountain is composed of the same granofels we will be studying along the East Branch Pleasant River. The valleys surrounding the mountain are underlain by portions of the Katahdin and Moxie plutons.

19.8 Road enters and leaves gravel pit.

20.30 **Upper member of the Carrabassett(?) Formation**

A rusty-weathering, banded, calcsilicate is exposed on the left-hand (southwest) side of the road. These rocks may be the upper member of the Carrabassett(?) (Boone, 1973, also known as the Hildreth Formation of Osberg and others, 1968). Compared to the surrounding rocks, these are highly folded. The upper member is generally thin and commonly responds to deformation by disharmonic folding.

20.66 The road to Jo-Mary Campground joins from the right(northeast). Do not turn, continue straight.

21.20 Road splits. Take lefthand fork. Continue straight, passing three gravel-based logging roads which enter from the left(south).

23.90 Road splits. Take lefthand fork toward Jo-Mary Pond.

24.40 Pass Jo-Mary Pond (not shown on map).

24.70 Road from Cedar Mountain joins from the south. Continue straight.

25.25 Turn left(south) on bumpy-crunky road to Gauntlet Falls. People having vehicles with low clearance must park here and hitch a ride.

26.10 **Stop 2: Madrid(?) Formation**

Park in clearing on west side of road.

The remainder of the trip will be devoted to looking at the rocks along the East Branch Pleasant River. A detailed map illustrating the geology and stops along the rivers is presented in figure 2.

An exposure of Madrid(?) lies along the east bank of the river west of the road. The rock is a purple-gray, biotite metasandstone with greenish-gray calcsilicate pods. The Madrid(?) and the massive metapelite at the next stop appear very similar on the fresh surface. However, the metasandstone lacks the cordierite pits and resistant porphyroblasts of andalusite which characterize the weathered surface of the metapelite.. Very faint laminations can be seen on the south end of the outcrop near the bank.

26.40 **Stop 3: Contact between Madrid(?) and Carrabasset(?)**
Slump folds

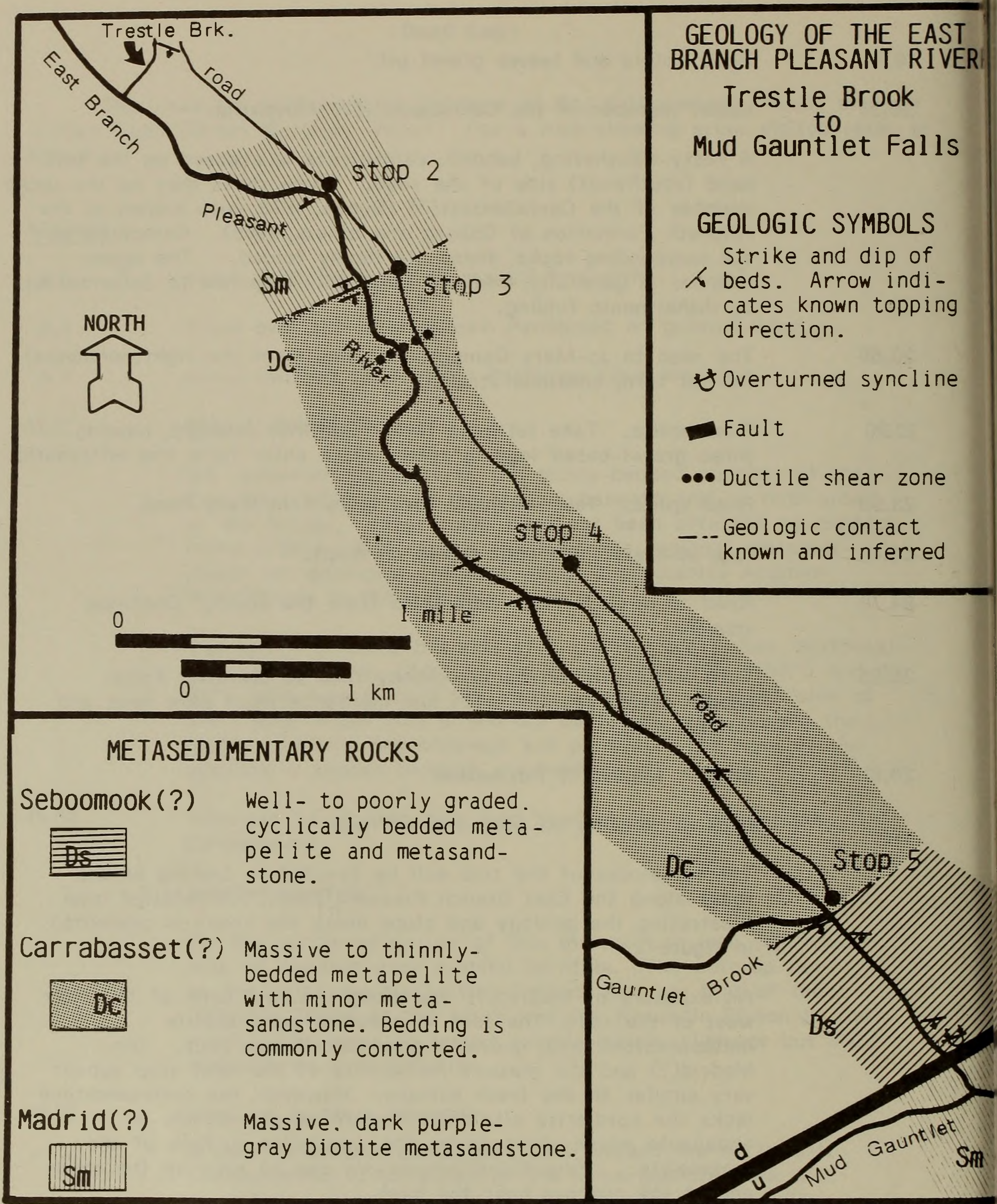


Figure 2. Geology and location of stops along the East Branch Pleasant River.

Park where possible allowing enough room for other cars to pass. Walk due west to the river, approximately 60 meters.

Stop 3A: Contact

Extending from the northwest shore are several small strike ridges of Madrid(?). Bedding is faint and often contorted. The contact lies south of these ridges and is covered with gravel.

The next set of exposures, south of the contact, are massive and bedded metapelites of the Carrabasset(?) Formation. The massive metapelite is best exposed on the east bank. The weathered surface of the granofels is highly pitted and andalusite crystals up to 1 cm long are visable. Overlying the massive metapelite is a bedded pelitic unit (best exposed on the west bank) containing thin beds of starved ripples. The apparent paleo-current indicated by ripple foresets is toward the ENE, parallel to the local tectonic trend.

Stop 3B: Slump Folds

Walk downstream to the next set of large outcrops(approximately 100 meters) and cross to the west bank. Looking across to the outcrop on the east bank several large slump folds are visable. The axes of the folds are exposed giving the outcrop a rounded appearance. The fold hinges appear to thicken toward the south and strike E-W.

Return to the road following the same route back. **Do not** head due east toward the road or you **will** be lost in an alder swamp.

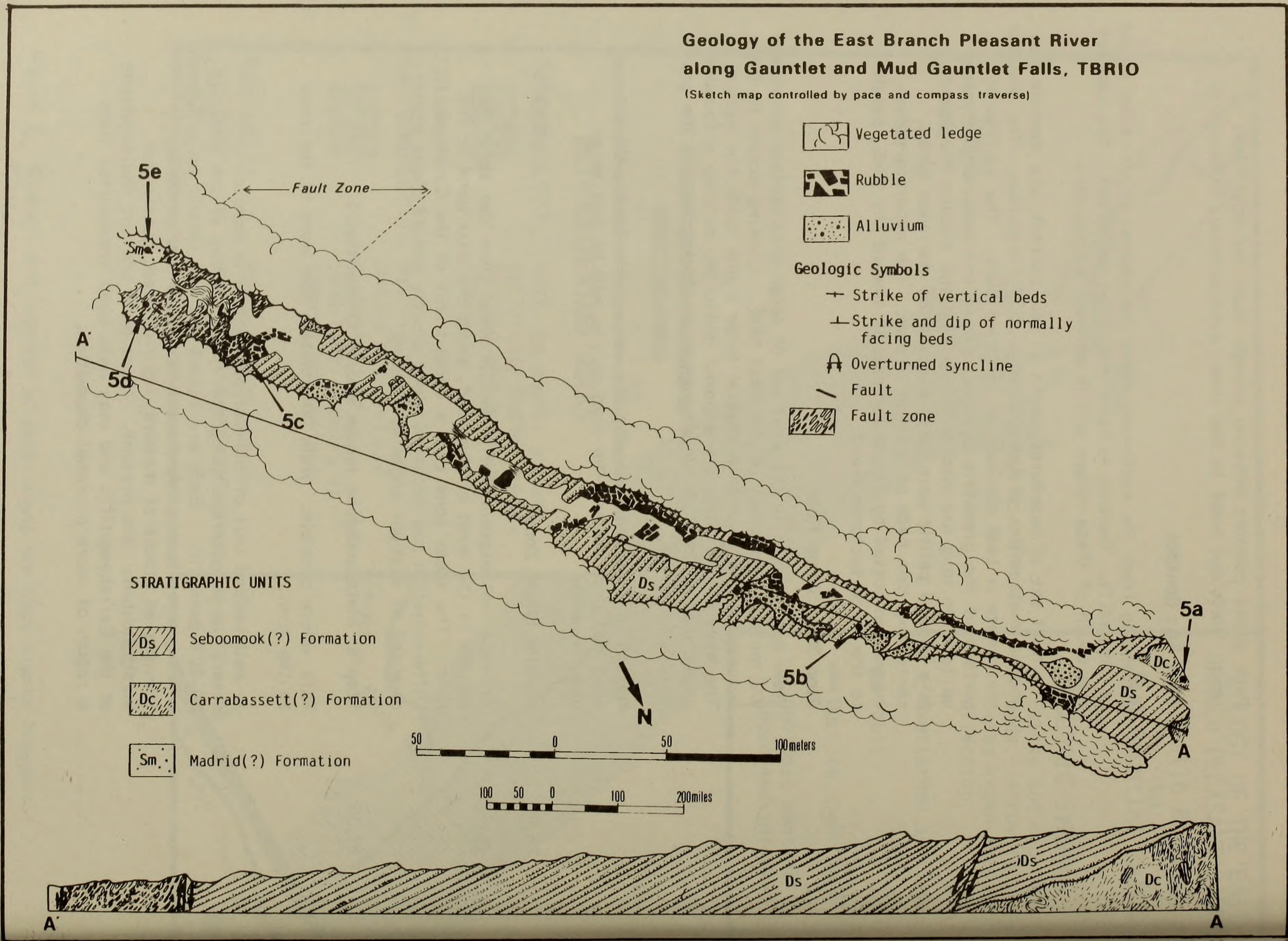
26.90 **Ductile Shear Zone**

An excellent exposure of a ductile shear zone lies about 30 meters to the west of the road, along the east bank of the river. The shear zone cuts a bedded unit of the Carrabassett(?). Differentiation has occurred along closely spaced shear planes oriented at a slight angle to bedding.

27.30 **Stop 4: Metasandstone lenses and/or Olistoliths(?)**

Park where possible. Walk 300 meters due west of the road to the river.

A well-bedded unit of the Carrabassett(?) is exposed in several large outcrops along the river. Many of the beds are 30-50% psamitic. Beds are folded and cut locally by numerous small gravity faults. A discontinuous bed and numerous transported blocks of massive, light-colored, quartz-rich meatsandstone are present. These beds are not characteristic of the Carrabassett(?) and may have been transported from a region of more proximal deposition.


Geology of the East Branch Pleasant River
along Gauntlet and Mud Gauntlet Falls, TBRIO
(Sketch map controlled by pace and compass traverse)
Vegetated ledge
Rubble
Alluvium
Geologic Symbols
Strike of vertical beds
Strike and dip of normally facing beds
Overturned syncline
Fault
Fault zone
STRATIGRAPHIC UNITS
Ds Seboomook(?) Formation
Dc Carrabassett(?) Formation
Sm Madrid(?) Formation
Fault Zone
5a
5b
5c
5d
5e
A
A'
N
Ds
Dc
Sm
50 0 50 100 meters
100 50 0 100 200 miles

27.80 **Stop 5: Contact between Carrabassett(?) and Seboomook(?)**
Detailed look at Seboomook(?) Formation
Overturned syncline and Mud Gauntlet Fault

Park in the large clearing at the head of Gauntlet Falls. For this stop consult the sketch map of the river from Gauntlet to Mud Gauntlet Falls (fig. 3).

Along both sides of Gauntlet Falls is a spectacular series of exposures showing the contact between the Carrabasset(?) and Seboomook(?) formations.

Stop 5A: Rocks near the Carrabasset(?) - Seboomook(?) contact

Walk across the river at the head of the falls.

The Carrabassett(?) is best exposed on the west side. On the water-worn surface the rock is light- to medium-gray, and bedding can be easily seen where present. The unit is dark- to medium gray and appears massive on highly weathered surfaces and where blasted. Bedding is highly contorted where visable. Blocks ranging from a few centimeters to more than a meter in length lie in a surrounding matrix of metapelite. Some blocks are composed of massive metapelite or sets of thin, well- to poorly-graded beds.

Looking across to to the east wall of the bedrock channel a faint, complex fold pattern is visable(figure 4). This exposure illustrates nicely the type of non-tectonic deformation which is so characteristic of the Carrabassett in the area.

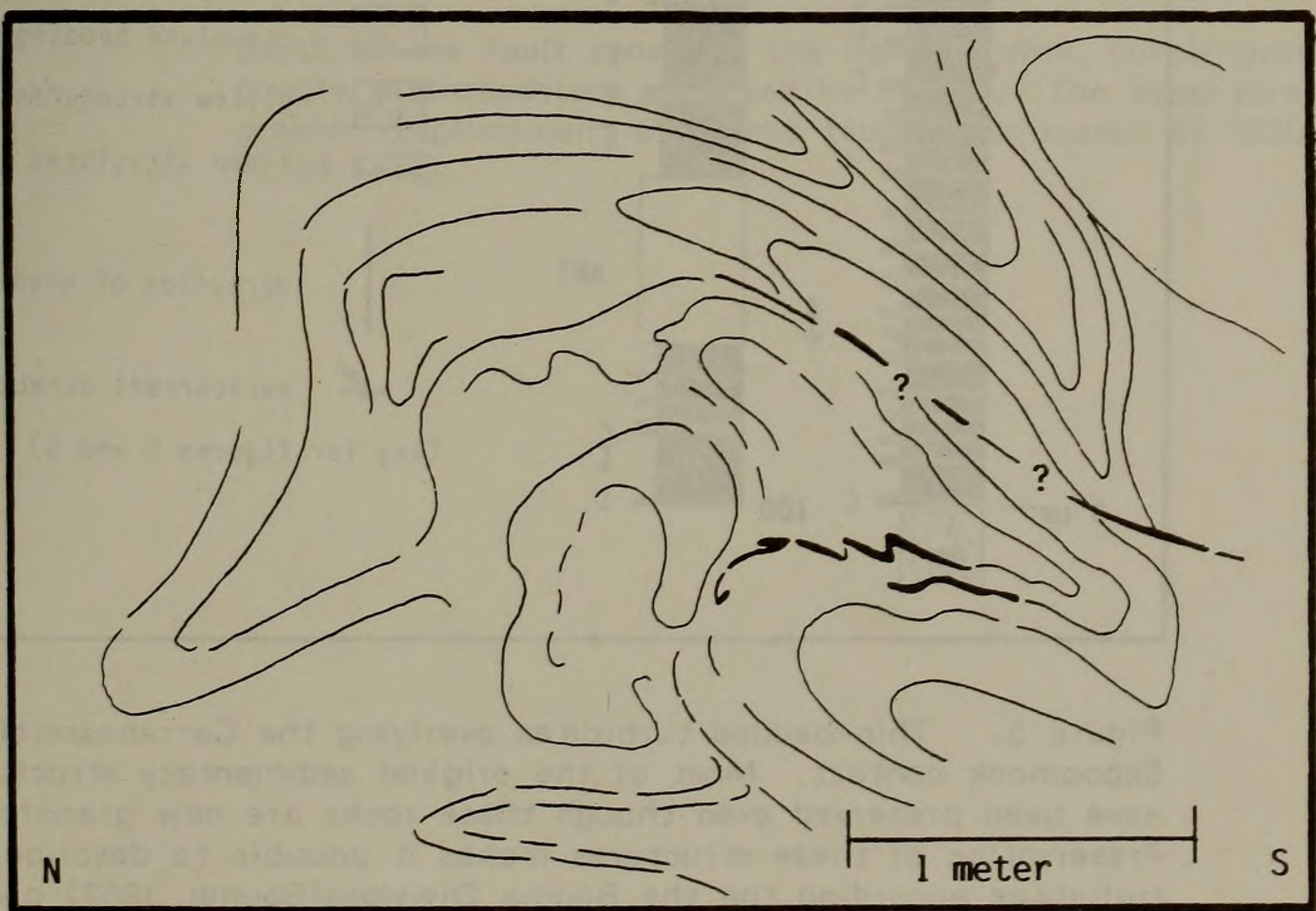


Figure 4. Slump folds in the Carrabassett(?) Formation at Gauntlet Falls.

The Seboomook(?) above the contact consist of thin-bedded, poorly-graded turbidites(fig. 5). The Metapsamitic beds are less than lcm thick and consist of starved ripples. The intervening metapelites are up to 15cm thick and show no grading. These beds of Seboomook would be categorized as CE divisions of the Bouma sequence and may represent back levee, levee, or basin-plain deposits.

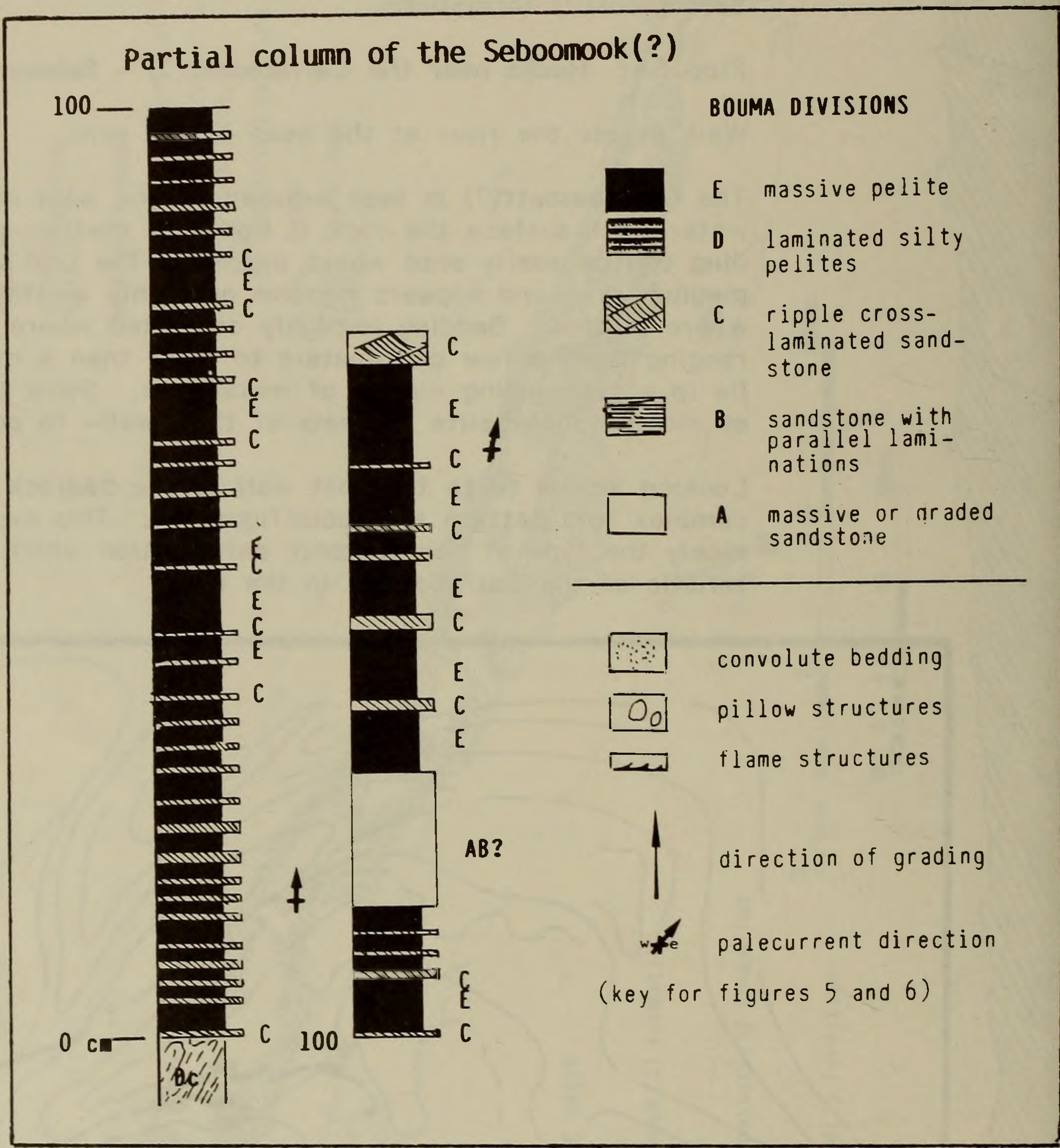


Figure 5. Thin-bedded turbidites overlying the Carrabassett(?)-Seboomook contact. Most of the original sedimentary structures have been preserved even though these rocks are now granofels. Preservation of these structures makes it possible to describe the turbidites accerding the the Bouma Divisions(Bouma, 1962) given above. The turbidites at the base of the Seboomook consist of thin, starved-ripple trains interlayered with massive pelite (CE).

Stop 5B: Thick-bedded unit of the Seboomook(?)

The thin-bedded turbidites which lie over the contact change quickly to thick-bedded, dominated by AB and BC sequences sequences (fig. 6). These rocks may represent a prograding suprafan lobe. The Seboomook changes back to thin-bedded before it is truncated by the fault.

Paleocurrents as determined from ripples are toward the north.

Stop 5c: Overturned syncline and beginning of fault zone

A fault on the south limb of an overturned syncline is exposed along a strike ridge approximately 5 m wide. This fault is the northeastern-most fault in the Mud Gauntlet Fault zone. The fault cuts the southwestern limb of an overturned syncline and brings up Carrabassett(?)-like rocks against the Seboomook(?). Beds on the northeast side of the fault are thin, well- to poorly graded, and strike N80°E. These beds are overturned, dipping 80° SE with tops toward the NW.

Stop 5D: Overturned syncline in fault zone

Within the fault zone is another overturned syncline, exposed on a water worn pavement. The fold is recognized by a thick, 15cm, metasandstone bed. Graded beds on the south side have tops toward the NE and those on the north side have tops to the South.

Stop 5E: Madrid on south side of fault

South of the fault zone lies the light to dark, purple-gray, biotite metasandstone observed at Stop 2. The total stratigraphic displacement along the fault is estimated at 2250 meters (7380 feet).

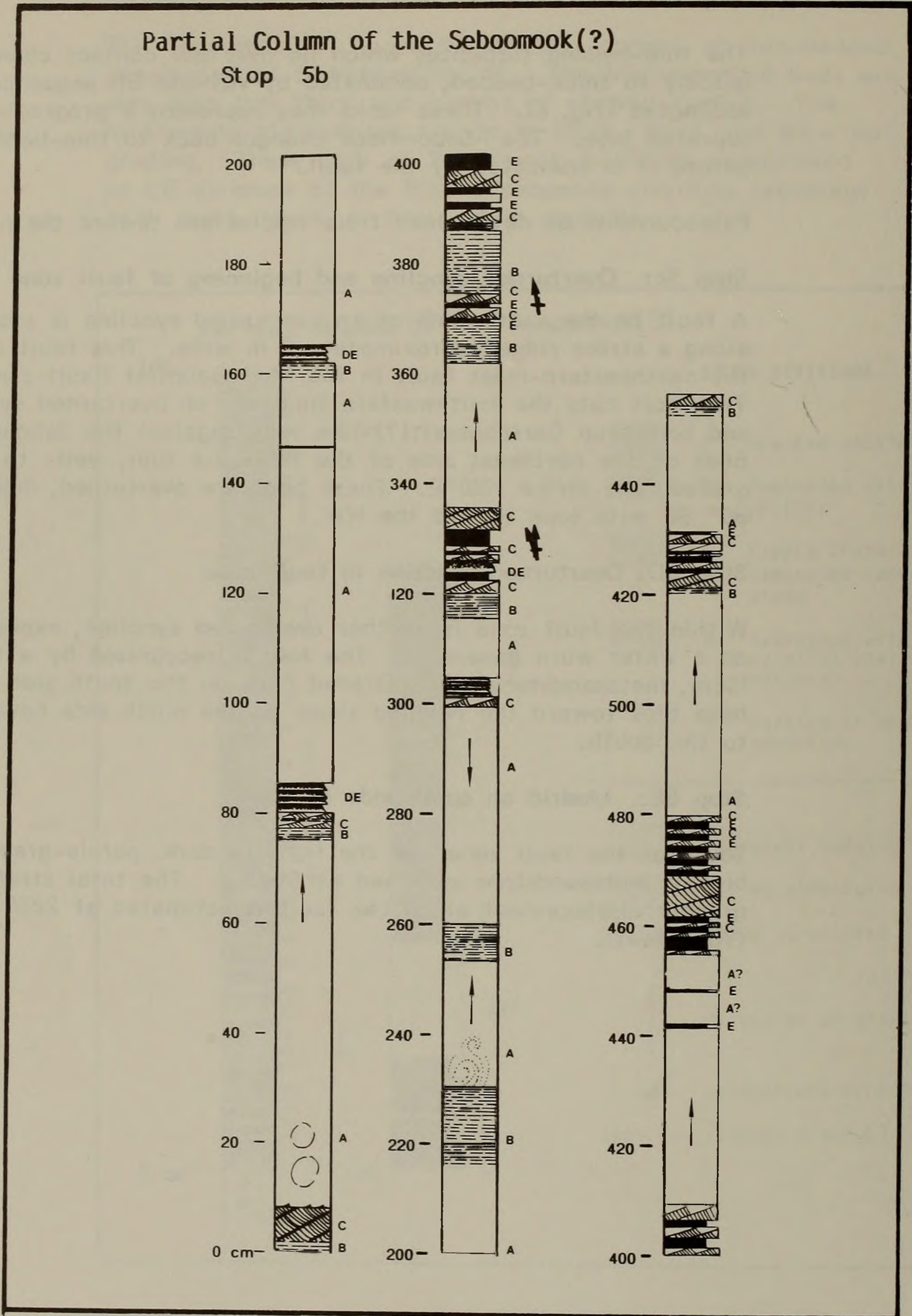


Figure 6. Thick-bedded turbidites of the Seboomook(?) exposed at stop 5b. In this section A and B divisions are much more prevalent and may indicate a prograding suprafan(Walker, 1976).