LA-UR-79-1817

CONF-790739--3

TITLE: STUDIES OF OFFSHORE PETROLEUM LEASES USING A CARTOGRAPHIC DATA BASE SYSTEM

AUTHOR(S): John L. Sibert

SUBMITTED TO: Harvard Computer Graphics Week, Cambridge Mass.
July 15-20, 1979

MASTER

University of California

LOS ALAMOS SCIENTIFIC LABORATORY
Post Office Box 1663 Los Alamos, New Mexico 87545
An Affirmative Action/Equal Opportunity Employer

Form No. 836 R3
St. No. 2629

UNITED STATES
DEPARTMENT OF ENERGY

STUDIES OF OFFSHORE PETROLEUM LEASES USING A CARTOGRAPHIC DATA BASE SYSTEM

by

John L. Sibert
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87545

An innovative system combining techniques of computer graphics and data base management has been developed at the Los Alamos Scientific Laboratory for the United States Geological Survey (USGS). The system is based on a CODASYL-type network data base management system. An interactive query language has been developed to allow standard data base retrievals as well as cartographic display of retrieval results. Map displays include both real-time display on a CRT terminal (such as a Tektronix 4014) and postprocessed full-color display on computer output microfilm.

Since the system became operational early in 1978, it has been used in a number of ongoing studies for both the USGS and the Department of Energy (DOE). The primary application to date has been verification of the Lease, Production, and Revenue data (LPR) amassed by the USGS as part of its regulatory responsibility. Over 150 color-coded maps of offshore areas in the Gulf of Mexico have been produced for comparison with hand-drawn originals. This has proved to be an effective verivication procedure, because differences between the maps are readily visible. Other current applications include provision of both data and displays for statistical studies of bidding behavior of oil companies for both USGS and DOE projects.

John L. Sibert
MS 600, Group S-1
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87545
USA
(505) 667-7303

STUDIES OF OFFSHORE PETROLEUM LEASES USING A CARTOGRAPHIC DATA BASE SYSTEM

INTRODUCTION

Since 1954 the US Government has offered for lease over 3500 tracts in the outer continental shelf (OCS) region. Some 83% of these offerings are located in the Gulf of Mexico, making it by far the most significant offshore petroleum region. As part of an ongoing research and development program sponsored by the Conservation Division of the US Geological Survey (USGS), the Los Alamos Scientific Laboratory has responsibility for maintenance of a data base containing production, revenue and bidding information for all offshore leases. The data base currently contains information for all tracts offered for sale from 1954 through 1977. (Offshore tracts are commonly referred to as offshore oil leases although strictly speaking "tract" refers to the physical location while a "lease" is a legal agreement, in this case between the government and one or more oil companies, to allow use of that physical location). Data for the 1978 sales are currently being added to the data base.

In addition to data items describing production, revenue, etc. the data base also contains the legal description of the location of each tract. The balance of this paper describes an effort to verify these descriptions using a cartographic data base system.

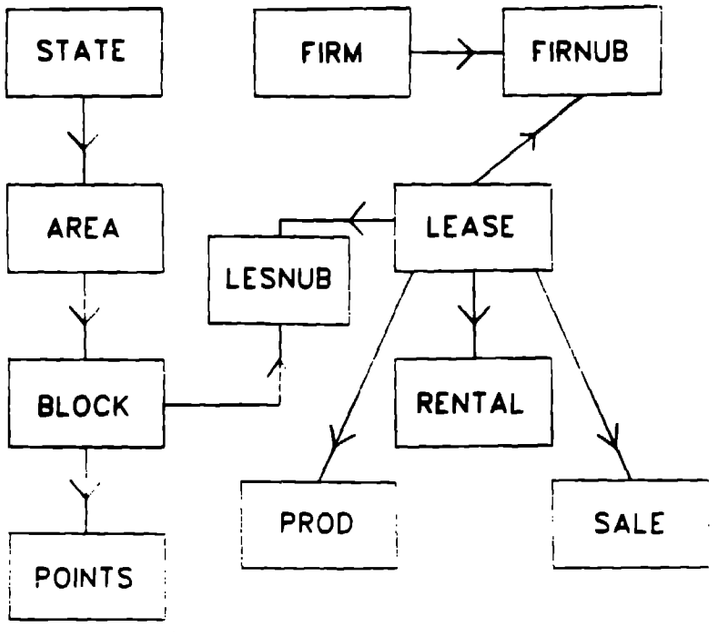

Fig. 1. Network Data Base Structure

DATA VERIFICATION PROCEDURE

During data compilation a series of seven (four Louisiana, two Texas and one MAFLA) maps, with tracts color coded by sale data, were produced by hand. In order to compare the contents of our data base with these originals, we produced a set of 143 color 35 mm slides each portraying seven sales for a single area with color coding selected to approximate that of the originals. A color xerox copy was made of each slide to facilitate comparison with the original manually produced maps.

The xerox copies were then compared to the originals and every discrepancy between the two was recorded. When possible the OCS number (a code uniquely identifying each tract) was recorded. In some cases, the OCS number was not recorded on the original and it was necessary to

use block and area designations. Along with the identification code, a brief description of the nature of the discrepancy was recorded. For example, if a tract appeared on the original but was missing from the slide, it would be recorded as "missing D.B.". A summary of the results of this procedure is given in Table I.

As can be seen from Table I, Louisiana has both the overwhelming majority of offshore tracts and, not surprisingly, of apparent errors as well. In addition, the proportion of tracts showing discrepancies is somewhat higher in Louisiana than in Texas. This may result from the higher complexity of the older land survey system in Louisiana, as well as, the fact that Louisiana was involved in twice as many sales as Texas. MAFLA (an acronym for Mississippi, Alabama, Florida, Louisiana) would appear to have an even higher percentage of discrepancies, but, ten of the thirteen turn out to have resulted from a single error in data loading.

TABLE I. OCCURRENCE OF DISCREPANCIES BETWEEN COMPUTER GENERATED AND HAND DRAWN MAPS.

	TEXAS	LOUISIANA	MAFLA	TOTAL
Tracts	728	2054	93	2875
Discrepancies	57	220	13	290
Percentage	7.83	10.71	13.98	10.09
Areas	27	43	13	83
Discrepancies	10	27	3	40
Percentage	37.04	62.79	23.08	48.19

The next step was to search the data base for each of the 290 tracts with discrepancies and try to determine the source of the difference. In some cases, supplementary maps were produced during this procedure. Figure 2 is an example of one of a series of such maps showing all tracts from a given sale. These maps were used to double check some corrections which were sent to us during our procedure, as well as, to see if comparison was truly facilitated by use of color. Although no rigorous testing was done, it did appear much easier to detect discrepancies using the color coded maps, rather than the black and white maps.

During our search of the data base, a number of causes were found for the differences in the original and computer generated maps. These are given in Table II along with their approximate percentage of occurrence. We found, as we expected, that most of the discrepancies could safely be attributed to common errors such as keypunch and recording errors. A few others were caused by programming bugs in the data base loading programs, while, the remainder are to be referred back to the original data sources for reconciliation.

CONCLUSIONS

The usefulness of any data base is directly related to the reliability of the data it contains. There are a number of methods both manual and automatic to verify the accuracy of data. The more traditional methods, such as comparing lists of numbers or performing checks on the topological consistency of the data file, were inadequate in this instance. The ability to perform visual comparisons of data mapped from the data base had two primary advantages. First, the

Lease Sale 10/13/1954

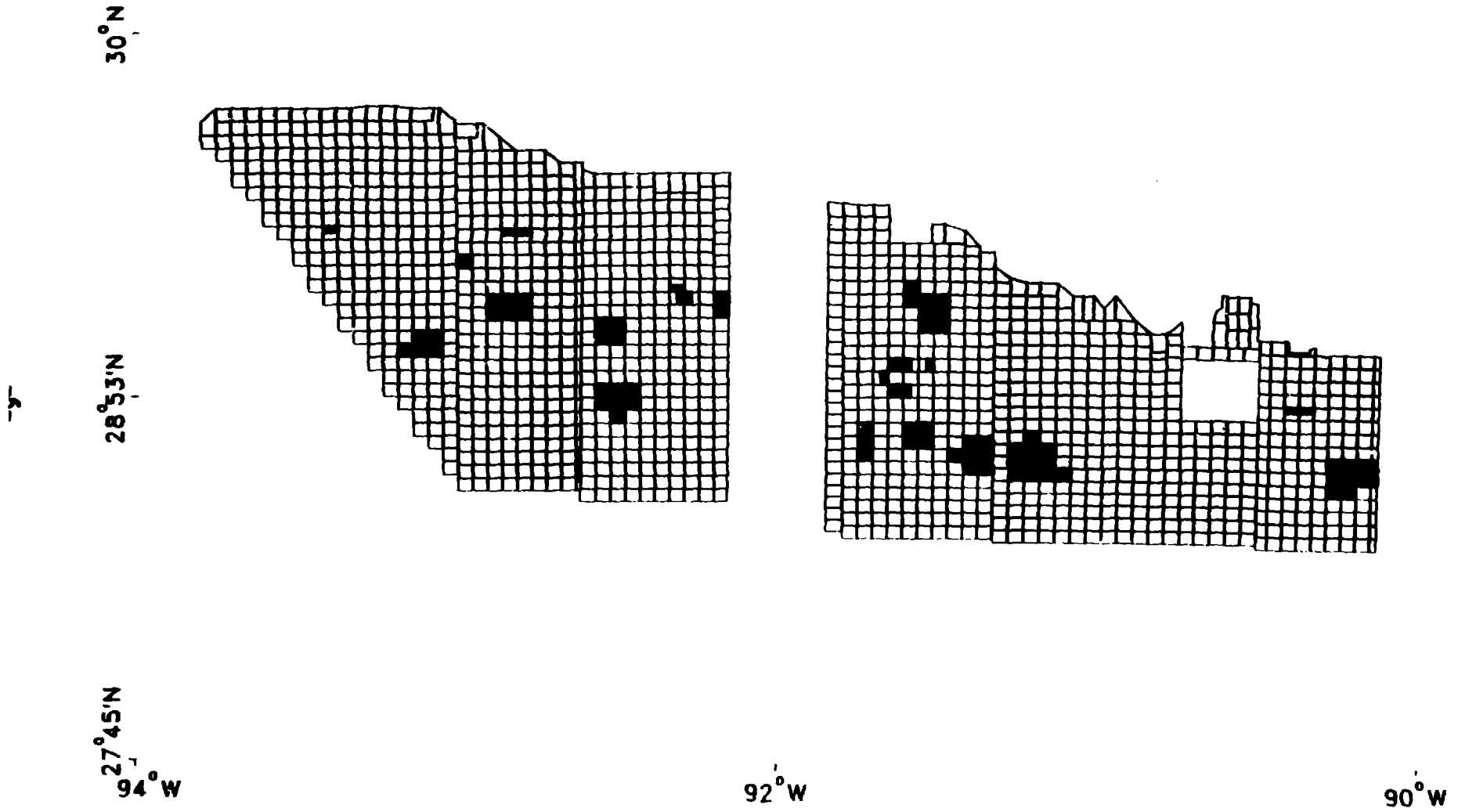

Fig. 2. Map Produced by Cartographic Data Base System

TABLE II. REASONS FOR DISCREPANCIES BETWEEN COMPUTER AUTO AND MANUAL MAPS

Category	Percentage
1. Bad Link Between Data Items*	15
2. Date Difference Between Maps	5
3. Erroneous Data Item*	25
4. Discrepancies in Rejection and Reoffer Codes	5
5. Missing Data Item*	15
6. "Garbaged" Data Item**	15
7. Bad AREA Record**	15
8. Disagreement in Legal Description	5

* Probable Data Entry Error
**Probable "Bug" Data Base Build Program

comparisons were done quickly. Less than one man-week of effort was necessary for the actual comparison. (Of course other parts of the procedure took considerable longer, but, that would have been the case regardless of how the comparison was done.) Second, since it was relatively easy to [illegible] discrepancies, the liklihood of some error being overlooked is greatly reduced. This is most important for data which is to be mapped when a single error, that might have been harmlessly submerged in the mass of data in a statistical analysis, may show up clearly.

The combination of data base management and cartographic capabilities has much wider applicability than the data verification task described above. We have begun to use the system in statistical studies of the

production and revenue data. Currently, we are also looking for further applications of the system in order to learn what future enhancements may be necessary. In the future, with constant advances in computer technology, and the theory of how to use it, systems such as ours will become much more commonplace, providing an invaluable tool in management of our natural resources.

FOOTNOTES

1. R. L. Phillips, "A Query Language for a Network Data-Base with Graphical Entities," Computer Graphics, Vol. 11, No. 2, (Summer 1977) 279-185.

2. R. L. Phillips and J. L. Sibert, "A Cartographic Query System for Management of Offshore Leases," Proceedings, Auto Carto III: International Symposium on Automation in Cartography, San Francisco, (Jan. 1978).

BIBLIOGRAPHY

CODASYL Data-Base Task Group, April 1971 Report, ACM, New York.

Hershey, E. A. and Messink, P. W., "A Data-Base Management System for PSA Based on DBTG 71," ISDOS Working Paper No. 88, University of Michigan (July 1975).

Heindel, L. E. and Roberto, J. T., LANG-PAK--An Interactive Language Design System, American Elsevier, New York (1975).

Phillips, R. L., "A Query Language for a Network Data-Base with Graphical Entities," Computer Graphics, Vol. 11, No. 2, (Summer 1977) 179-185.

Phillips, R. L. and Sibert, J. L., "A Cartographic Query System for Management of Offshore Leases," Proceedings, Auto-Carto III: International Symposium on Automation in Cartography, San Francisco, (January 1978).