



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

NOV 19 1979

MEMORANDUM FOR: Harold R. Denton, Director  
Office of Nuclear Reactor Regulation

Robert B. Minogue, Director  
Office of Standards Development

FROM: Saul Levine, Director  
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER NO. 69  
AN INTEGRATED GEOPHYSICAL AND GEOLOGICAL STUDY OF THE  
TECTONIC FRAMEWORK OF THE 38TH PARALLEL LINEAMENT IN  
THE VICINITY OF ITS INTERSECTION WITH THE EXTENSION OF  
THE NEW MADRID FAULT ZONE

REFERENCES:

1. Letter W. R. Stratton to Dixie Lee Ray dated May 16, 1973. Subject: Report on Seismic Research.
2. Title 10, Chapter 1, Part 100, CFR Appendix A - Seismic and Geologic Siting Criteria for Nuclear Power Plants.
3. Memo: N. B. Steuer to R. J. Mattson dated July 15, 1975. Subject: U.S. Tectonic Province Map.

This memo transmits NUREG/CR-0449 entitled "An Integrated Geophysical and Geological Study of the Tectonic Framework of the 38th Parallel Lineament in the Vicinity of Its Intersection with the Extension of the New Madrid Fault Zone." The research effort to produce this report was conducted by Purdue University, Department of Geosciences in FY 78, in cooperation with the University of Texas and the University of Pittsburgh Geoscience Departments. This effort was conducted under the direction of Prof. W. J. Hinze of Purdue University as a part of the New Madrid Cooperative program. NUREG/CR-0449 is an interim document reflecting information available as of 1978 and its conclusions may be modified at a later date.

SUMMARY OF THE NEW MADRID COOPERATIVE PROGRAM

This study is a part of the "New Madrid Seismotectonic Study" which is a coordinated program of geological, geophysical, and seismological investigations of the area within a 200 mile radius of New Madrid, Missouri. The study is designed to define the structural setting and tectonic history of the area in order to realistically evaluate earthquake risks in the siting of nuclear facilities. An important goal of the research program is to produce useful seismotectonic and seismic zoning maps for the study area.

Extensive gravity and aeromagnetic surveys have been conducted in critical areas of Kentucky, Illinois, and Indiana centering around the intersection of the 38th Parallel Lineament and the extension of the New Madrid Fault Zone. Available aeromagnetic maps have been digitized and these data have been processed by a suite of computer programs developed for this purpose. Seismic equipment has been prepared for crustal seismic studies and a 150 km long seismic refraction line has been observed along the Wabash River Valley Fault System. Preliminary basement rock and configuration maps have been prepared based on studies of the samples derived from basement drill holes. Interpretation of these data is only at a preliminary stage, but studies to this date indicate that the 38th Parallel Lineament features extend as far north as 39°N and a subtle northeasterly-striking magnetic and gravity anomaly cuts across Indiana from the southwest corner of the state, roughly on strike with the New Madrid Seismic Zone.

The 38th Parallel Lineament is a band of geologic features extending across eastern U.S. along the 38th parallel of latitude. It is manifested in many ways, but primarily by a series of east-west trending fault zones which were active at least through the Paleozoic era. It may represent a Precambrian fracture zone or crustal boundary extending deeply into the crust and possibly the mantle. The northeasterly-trending New Madrid Fault Zone has been the site of several intermediate and major earthquakes in historic time and is the most seismically active area in eastern North America. The trend of the New Madrid Fault Zone extends into southern Illinois and Indiana and the Wabash River Valley Fault System. This trend intersects the 38th Parallel Lineament in the vicinity of the confluence of the Wabash and Ohio Rivers. Fundamental questions of the New Madrid Fault Zone are its extension to the northeast and the nature of its intersection with the 38th Parallel Lineament. These questions are particularly significant to the evaluation of earthquake risk in the region.

This program is a part of the New Madrid Seismotectonic Study and is being coordinated with all NRC funded programs in the New Madrid area. Results of these and other studies are presented in biannual symposiums and are being utilized and will be utilized to formulate conclusions and plan future investigations.

The major products completed and efforts underway to date include the following:

1. Develop computer codes for gridding, contouring, and processing gravity and magnetic data.
2. Prepare Bouguer gravity anomaly maps of western Kentucky.
3. Conduct gravity survey of central Kentucky and southwestern Indiana, reduce data and prepare preliminary Bouguer gravity anomaly maps.

4. Prepare Bouguer gravity anomaly maps of Dyersburg Sheet (88°-90°W and 36°-37°N) and Paducah Sheet (88°-90°W and 37°-38°N).
5. Digitize and grid southwestern Illinois (south of 39°N and west of 89°W) aeromagnetic data.
6. Digitize and grid Indiana aeromagnetic data. Analyze geomagnetic field removal problem and prepare total magnetic intensity anomaly map. Prepare interpretational maps (filter, second derivative, etc.) and preliminary interpretation.
7. Conduct aeromagnetic survey of southeastern Illinois (south of 39°N and east of 89°W), reduce data, and prepare anomaly map. Complete aeromagnetic tie lines across Illinois and Indiana.
8. Prepare seismic equipment for crustal seismic studies and conduct a refraction line along Wabash River Valley Fault System.
9. Prepare preliminary basement rock and configuration of basement surface maps from basement drill hole records and samples.
10. Prepare bibliography on tectonics of the New Madrid area.
11. Prepare "Tectonic Overview of the Central Midcontinent."
12. Initiate petrologic investigation of the ultramafic and mafic intrusions of the midcontinent.

#### PLANNING

Initially, a five-year program was planned. General plans for the first four years are depicted on Figure 1, "A Schematic Program Summary."

#### BACKGROUND

##### Support for Licensing Decisions

Refer to RIL No. 48 "A Tectonic Overview of the Midcontinent." The background information in RIL 48 applies equally to this RIL. It covers ACRS recommendations, relevance of 10 CFR Part 100 Appendix A to the study, and previous NRC effort and organization of the current programs.

##### Criteria for Study Area Selection

Late in 1811 and early in 1812, the New Madrid area, which includes the area covered in NUREG/CR-0449, was the site of the strongest series of earthquakes ever recorded in the central United States. The Saint Louis University seismograph network recorded close to 200 seismic events each year for the past two years, indicating that the area continues to be seismically active. Evaluating seismic risk for the surrounding region, especially when consideration is given to the siting of nuclear facilities, requires a better understanding of the structure and tectonics of the area and their relationship to the seismicity than is presently available.

## RESULTS

NUREG/CR-0449 presents results of gravity and aeromagnetic surveys conducted in critical areas around the intersection of the 38th Parallel Lineament and the extension of the New Madrid Fault Zone. Available aeromagnetic maps have been digitized and these data have been processed by a suite of computer programs developed for this purpose. Seismic equipment has been prepared for crustal seismic studies and a 150 km long seismic refraction line has been observed along the Wabash River Valley Fault System. Preliminary basement rock and configuration maps have been prepared based on studies of the samples derived from basement drill holes.

Interpretation of these data is only at a preliminary stage, but studies to this date indicate that the 38th Parallel Lineament features extend as far north as 39°N and a subtle northeasterly-striking magnetic and gravity anomaly cuts across Indiana from the southwest corner of the state, roughly on strike with the New Madrid Seismic Zone.

Study results are being used by Rondout Associates, Inc., in a program funded by the NRC Office of Nuclear Reactor Regulation to produce a seismic zoning map of the eastern U.S. Additionally, project data are considered by the NRR staff in making licensing decisions.

## RECOMMENDATIONS

While these interim results are not definitive, we recommend that the current practice of extending the New Madrid 1811-1812 earthquakes north of the Rough Creek Fault Zone (38th Parallel Lineament) be continued until additional data being developed indicate that this practice should be changed. It is also recommended that the information in NUREG/CR-0449 be considered by the Office of Standards Development and the Office of Nuclear Reactor Regulation as input to the development of a tectonic province or seismic zoning map of the eastern U.S. and to provide a basis and guide for ongoing studies in the area.

The interpretation of existing data is preliminary. Additional work is planned. Researchers may want to complete interpretation of existing data so that this information can be used to plan future studies, including a long seismic line along the Wabash Valley River Fault System.

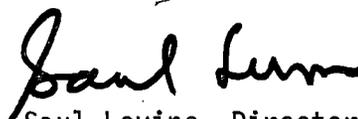
Additionally, RES recommends that studies be continued in this area to attain the objectives previously stated, with redirection and modification of projects as deemed necessary by ongoing work.

Harold R. Denton  
Robert B. Minogue

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Technical questions concerning NUREG/CR-0449 may be directed to Neil B. Steuer at 427-4370.



Saul Levine, Director  
Office of Nuclear Regulatory Research

Enclosure:  
NUREG/CR-0449

NEW MADRID EXTENSION - 38th PARALLEL LINEAMENT  
INTEGRATED INVESTIGATION

PROGRAM SUMMARY

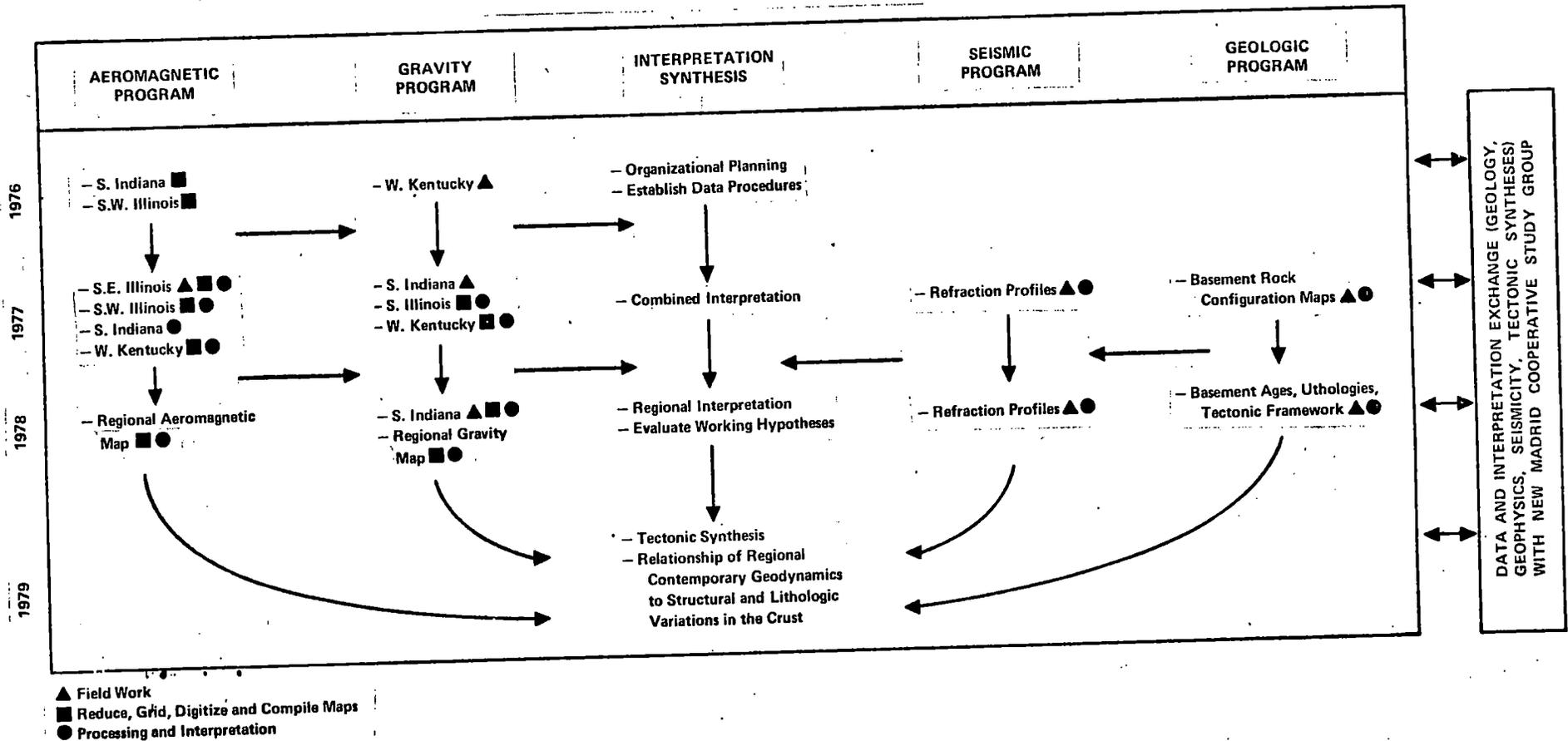


Figure 1.  
Flow Chart Which Schematically Summarizes the New Madrid Extension - 38th Parallel Lineament Program.

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Original Signed By  
Saul Levine

Saul Levine, Director  
Office of Nuclear Regulatory Research

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