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During April, May and June, 1982, significant progress has been made on several aspects of the research program. In addition, reports on activities were presented at a coordination meeting of the New Madrid Seismo-Tectonic Study Group in West Lafayette during the North-Central Regional Meeting of the Geological Society of America in April, 1982.

Principal efforts during this quarter were directed towards preparing for summer field activities in the greater Anna, Ohio area. A field crew was initiated in early May to survey gravity data that will fill gaps in the currently available data coverage. This field crew began surveying in early May and will continue into the next quarterly period. Meanwhile, gravity data being collected are undergoing reduction and integration with pre-existing data. Magnetic data in the greater New Madrid area obtained during the Department of Energy's National Uranium Resource Evaluation aerial radiometric and magnetic surveys

have been obtained for analysis and interpretation. In addition, regional gravity and magnetic anomaly maps centered around the Anna area are being prepared. These maps cover sufficient area of the Grenville Front and postulated Precambrian rifts to provide a regional tectonic framework for our studies. An analysis of the gravity, magnetic, seismicity and basement geology data in the east-central midcontinent are continuing in our efforts to further integrate the available data on the extensions of the New Madrid Seismic Zone.

Research has been initiated on the basement rocks of Ohio with particular emphasis on the Anna, Ohio, area and adjacent regions. Samples from about 125 wells to basement have been obtained from the Ohio Geological Survey in Columbus. Binocular and thin section study of these samples is now underway.

A major effort during this quarterly period was completion of a manuscript entitled "The Role of Rifting in the Tectonic Development of the Midcontinent", USA" by G.R. Keller, E.G. Lidiak, W.J. Hinze and L.W. Braile. This manuscript, which has been submitted for publication in a special issue of Tectonophysics, develops the theme that rifts are likely candidates for tectonic reactivation and occur widely throughout much of mid-America. The extent of rifting in space and time in the midcontinent is discussed. This is a timely manuscript because of the increasing awareness of the role of ancient rifts in controlling seismicity of intra-plate areas. The abstract of this manuscript is attached. In addition, Bouguer gravity anomaly maps of eastern and central Kentucky are being published by the Kentucky Geological Survey utilizing data in part acquired during our previous studies related to the extensions of the New Madrid Seismic Zone. A paper entitled "K-Ar Ages of Phlogopite from Mica Peridotite, Omaha Oil Field Intrusion, Gallatin County, Southern Illinois" was presented at the North-Central Section Meeting of the Geological Society of America in April.

Another paper entitled "Basal Sandstones in the Subsurface of the Central Midcontinent" has been accepted for presentation at the 1982 Annual Meeting of The Geological Society of America. Copies of these abstracts are attached. An oral presentation on the "Regional Tectonics of Western Kentucky and Adjacent Areas" was made at the Annual Kentucky Oil and Gas Association Meeting in June.

# THE ROLE OF RIFTING IN THE TECTONIC DEVELOPMENT OF THE MIDCONTINENT, U.S.A.

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Recent studies have proposed the existence of several major ancient rift zones in the midcontinent region of North America. Although the dating of some of these rifts (and even the rift interpretations) are subject to question, an analysis of these "paleo-rifts" reveals three major episodes of rifting: the Keweenawan (≅ 1.1 b.y.a.), the Eocambrian (≅ 600 m.y.a.), and the early Mesozoic. The extent of these rifting events documents that rifting has played a major role in the tectonic development of the midcontinent region. This role goes well beyond the initial rifting event because these features display a strong correlation with Paleozoic basins and a strong propensity for reactivation. For example, the Eocambrian Reelfoot rift was reactivated in the Mesozoic to form the Mississippi embayment and is the site of modern seismicity which suggests reactivation in a contemporary stress field of ENE compression. Even though the importance of rifting can be established, recognition of rifts and delineation of their complexities remain a major problem which requires more study.

# K-AR AGES OF PHLOGOPITE FROM MICA PERIDOTITE, OMAHA OIL FIELD INTRUSION, GALLATIN COUNTY, SOUTHERN ILLINOIS

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K-Ar ages have been determined on phlogopites from mica peridotite of the Omaha field intrusion. The intrusion cuts Upper Mississippian strata of Chesterian age; similar intrusives in the district set the time of intrusion as post-Lower Pennsylvanian (Atokan/Desmoinesian). Fine-grained phenocrystic phlogopite is dated at 290 ± 6 m.y., a probable maximum age, and broadly consistent with the stratigraphic relations. Six K-Ar and Rb-Sr ages on mica and hornblende from other intrusions in the region (Zartman and others, 1967) range from 258-289 m.y. and average 274 m.y. These ages probably represent the approximate time of emplacement during late Pennsylvanian-early Permian time. An older date of 408 ± 8 m.y. is obtained on a separate of coarse-grained phlogopite, predating the enclosing sedimentary rocks and clearly anomalous. Petrographic study indicates that the coarse micas are phenocrysts rather than xenocrysts and the date reflects the presence of excess radiogenic Ar. Excess Ar may also be present in the finer-grained phlogopite, and 290 m.y. may thus represent a maximum age of the intrusion.

The Ar determinations were duplicate analyses of a single fusion for each sample, run statically, using a double spike, and corrected for fractionation. K analyses were done by ion-selective electrode electrochemistry, the first use of this technique in K-Ar dating.

| Sample | K% | $^{40}Ar \times 10^{-9}$ m/g | $^{40}Ar/^{40}K \times 10^{-2}$ | Date | |
|---|---|---|---|---|---|
| EGL-1 | 5.81 | 3.238 | 1.867 | 295.7 | 290 ± 6 |
| fine | | 3.121 | 1.800 | 285.9 | |
| EGL-2 | 6.27 | 5.005 | 2.674 | 409.9 | 408 ± 8 |
| coarse | | 4.943 | 2.642 | 205.5 | |

# BASAL SANDSTONES IN THE SUBSURFACE OF THE CENTRAL MIDCONTINENT, UNITED STATES

by

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The central Midcontinent, part of the cratonic interior, has distinctive gravity and magnetic anomaly patterns which outline a prominent zone of earthquake epicenters and inferred buried rift structures (New Madrid Rift Complex). Recent study of the rocks from deep wells in the general area of the rifts reveals the presence of sedimentary rocks older than the Mt. Simon Sandstone (Upper Cambrian). In contrast to the widespread Mt. Simon Sandstone, these older sedimentary rocks are apparently restricted to the rift structures, suggesting that they accumulated or were preserved in ancient rift zones.

The Mt. Simon Sandstone is a quartzose to feldspathic, submature to mature sheet-like sandstone which in the study area decreases in thickness southward from 2600 feet in northeastern Illinois to less than 500 feet in southern Illinois and adjacent areas. Within the rifts, the pre-Mt. Simon Sandstone lies immediately beneath the Mt. Simon, where it is defined mainly by anomalous sandstone thickness and more diverse lithology than is typical of the Mt. Simon. The pre-Mt. Simon Sandstone is generally finer grained, more argillaceous, more feldspathic, and contains more intervals of red shales and red silty shales than the Mt. Simon. The presence of authigenic epidote in some areas and the lack of tourmaline in the pre-Mt. Simon also distinguish the sandstone from the Mt. Simon

The restricted distribution of the pre-Mt. Simon further corroborates the presence of a buried rift complex in the central Midcontinent. These rocks are thus of considerable importance in providing new insight into the tectonic development of the region in latest Precambrian-Cambrian time.