uplift. Marker beds within natural levee deposits define a monocline that parallels the ground surface with more than 5 m of down-to-the-east vertical separation. This fold contains four 1 m amplitude flexures each having numerous west-dipping normal faults. The faults have a total net vertical separation of about 0.4 m in a down-to-the-west sense, which is opposite to that exhibited by the scarp and the marker beds. We believe these faults are related to extension in the crest of the monocline, and that the monocline represents deformation above a west-dipping reverse fault that reaches or approaches the ground surface east of the base of the scarp. The trench data also reveal at least two episodes of deformation: one in A.D. 1811-12, and one between A.D. 1310±90 and A.D. 1540±90. Thus, the time between the two most-recent earthquakes large enough to produce liquefaction and/or surface deformation was about 200 to 600 years.

Holocene deformation associated with the scarp and the Lake County uplift is revealed in mapped meander patterns of the Mississippi River. Meander domains indicate that Holocene deformation of the Lake County uplift forced a northwesterly migration of the river, and that anticlinal growth progressed from southeast to northwest.

№ 6463

RE-EXAMINATION OF MODELS FOR THE ORIGIN OF GRANITE-RHYOLITE PROVINCES IN THE MIDCONTINENT REGION, USA.

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New isotopic data for the 1.47 Ga Eastern Granite-Rhyolite Province and the 1.37 Ga Southern Granite-Rhyolite Province require re-examination of models for the origin of these suites of rock. For the most part, eNd(t) values for the granite-rhyolite provinces and A-type plutons intrusive into adjacent Early proterozoic basement are compatible with origin through melting of 1.8 Ga continental crust (Nelson and DePaolo, 1985). However, new data (Bowring et al., 1992) show that southeastern parts of the granite-rhyolite provinces yield positive εNd(t) values, which can only be explained by derivation from 1.5 Ga continental crust. The transition from older substrate (1.8 Ga) to younger substrate (1.5 Ga) occurs along a NE-SW line from Detroit, MI to eastern Oklahoma; it probably represents the edge of the pre-1.6 Ga craton. A further variation in εNd(t) data is an E-W trending belt of intermediate values in northern Oklahoma; εNd(t) data south of this belt, in S. Oklahoma, are equivalent to that in Kansas and Nebraska, reflecting ca. 1.8 Ga lower crust.

The granite-rhyolite provinces are not related to any well defined tectonic event, and they have commonly been referred to as "anorogenic". The thermal event responsible for producing the silicic melts may have been associated with an extensional regime, in view of the A-type character of the granites. However, the 1.5 Ga crust underlying the SE parts of the granite-rhyolite provinces suggests that there may be a 1.5 Ga magmatic arc accreted to the margin of the 1.6 Ga craton. Formation of this arc must have been followed within a few tens of m.y. by a major rise in the geotherm which melted not only its lower crustal regions, but also Early Proterozoic crust throughout the U.S. A similar event must have followed about 100 m.y. later, affecting the south-central region. The intermediate εNd(t) values in Oklahoma may denote an E-W zone of crustal extension in which melts formed from 1.8 Ga crust with a significant contribution from 1.37 Ga mantle-derived magmas (fractional crystallization of mafic magmas at the base of the crust?). The heat for the regional 1.47 Ga magmatism is problematical, but the presence of a continental margin along the SE edge of the craton suggests a tectonic regime similar to that which produced voluminous felsic volcanic suites of the Cordillera (shallow subduction of delamination of continental lithosphere?). Restriction of melting to Early Proterozoic provinces resulted either because the Archean craton was not fertile enough to produce A-type melts, or because a deeper keel to the Archean craton prevented an influx heat.

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№ 6471

WERE THE WEST AFRICAN, CONGO, SÃO FRANCISCO, AND AMAZON CRATONS JOINED BEFORE THE FUSION OF GONDWANALAND?

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Reconstructions of Gondwanaland show the West African Craton (WAC), Congo Craton (CC), São Francisco Craton (SFC) and Amazon Craton (AC) clustered with intervening 600 Ma PanAfrican-Brasiliano structural belts. There is a common perception that SFC-CC was a single continental mass prior to 600 Ma and that it was juxtaposed with the AC and WAC during the formation of Gondwanaland. If this were the case, then pre-600 Ma geologic relationships on the SFC and CC should be similar across the Atlantic, and there should be major structural discontinuities among the WAC, AC, and CC-SFC.

The U-Pb zircon age for the Ebolowa charnockite of the northern CC in south Cameroon is 2,896 ± 7 Ma. Sm-Nd T(DM) ages are about 3,000 Ma, indicating that the northern CC does not contain major contributions from older Archean crust. Zircons from younger Nyong Series gneisses are complex mixtures formed during a high-grade metamorphic and plutonic event about 2,050 Ma. Sm-Nd T(DM) ages for Nyong metasedimentary gneisses are 2,500 to 2,900 Ma, indicating derivation mainly from the Archean craton. A late syenitic pluton yields a zircon age of 590 Ma, representative of PanAfrican igneous activity, but the PanAfrican thermal overprint is not apparent in U-Pb or Sm-Nd data for most of the CC. PanAfrican gneisses have been thrust southward over the northern CC; metamorphic zircons yield U-Pb ages of ca. 620 Ma on metamorphic zircon, and Sm-Nd T(DM) ages are ca. 1.5 Ga, indicating a mixed provenance.

Granulitic basement in the foreland of the Sergipiano fold belt, northern SFC, yields a U-Pb zircon age of ca. 2,250 Ma with little evidence of Archean parentage or inheritance. Detrital zircons from low-grade metasedimentary rocks yield Pb-Pb ages of 2.1 Ga; Archean detrital zircons are absent to very minor. Zircons from low-grade metavolcanic rocks in the Sergipiano fold belt yield ages of 1,100 to 1,000 Ma. We have also sampled many units northward from the SFC toward the WAC in an attempt to define the primary and metamorphic history further. Sm-Nd T(DM) ages for 600 Ma Brasiliano granites are 1.3 to 1.6 Ga, suggesting absence of Early Proterozoic to Archean crust in the southern Borborema Province but showing similarity to PanAfrican gneisses in Cameroon. These results fit a model in which the SFC and CC were joined prior to 1,100 Ma and formed the foreland to 1,100 Ma sedimentation on and adjacent to a continental margin; these rocks were later deformed as the WAC and AC converged toward the SFC-CC during Gondwanaland fusion. However, many details remain to be resolved.

№ 2127

A LATE-HOLOCENE SURFICIAL SANDBLOW IN THE WESTERN LOWLANDS OF SOUTHEAST MISSOURI: A PALEOSEISMIC MILESTONE

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Shallow trenches excavated across an elongate mound of sand showed several characteristics consistent with an extrusive paleoearthquake origin. Numerous clastic dikes, sills, and intruded cavities immediately underlie the sandblow; and discontinuous eruptive vents and occasional small clasts were located within the sandblow. An adjacent ditch exposure indicates that the sandblow formed by the venting of sand up through seven or more meters of fine-grained alluvium--a likely result of seismic liquefaction.

Soil-morphological characteristics which suggest a prehistoric age include: 1) dominant yellowish brown Munsell color (10YR 5/4 and 5/6) beneath the A horizon of the sandblow, 2) absence of bedding planes in the sandblow, and 3) absence of a buried A horizon immediately beneath the sandblow. In contrast, sandblows produced by the great 1811-12 New Madrid earthquakes are typically dull colored, often have traces of bedding just under the A horizon, and are intermittently underlain by buried A horizons of the pre-earthquake surface soils.

Formation of this prehistoric sandblow may have occurred contemporaneously with paleoliquefaction and tectonic deformation previously identified by others in the vicinity of New Madrid, Mo. A calibrated ^{14}C date of 770-1020 A.D. on wood obtained just beneath the sandblow overlaps considerably a calibrated paleoearthquake timing of 539-991 A.D. for a site 30 km northeast of New Madrid. Assumming that these data represent the same event and that the seismic source was near New Madrid, the 60-70 km epicentral distance to this large sandblow in the Western Lowlands suggests a paleoearthquake magnitude of about 7.0 or greater.

№ 4246

POSITION OF THE ANORTHOSITE-RAPAKIVI SUITE AMONG OTHER TYPES OF IGNEOUS ROCKS.

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Every pluton may be represented by its natural sequence of magmas (rocks). Two types of natural sequences may be distinguished: epigenetic and syngenetic. Epigenetic natural sequence represents a consecutive order of intrusive phases of a pluton, formed during differentiation of magma in an intermediate magma chamber. Syngenetic natural sequence is represented by facies varieties formed within separate intrusive phases.

Mean chemical analyses of phases and facies of 80 plutons were plotted on variation diagrams, the most important of which was $(FeO+MgO)$-CaO-$2A1_2O_3$-SiO_2 (excepting FeO amalgamated in ore minerals). Consideration of the natural sequences of magmas (rocks) in this and other variation diagrams permits their assembly into 10 associations. The natural sequences (or vectors of differentiation) of plutons of the anorthosite-rapakivi suite (as natural sequences of all other associations) occupy their own definite place in the diagram.

Such complexes as the Berdiaush pluton (southern Ural) and the potassic granite plutons of Karelia and Kola Peninsula designated as "rapakivi," occupy quite different positions from the rapakivis of the anorthosite-rapakivi association in the diagram.

№ 2135

THE ANCIENT RAPAKIVI-LIKE GRANITES OF THE BALTIC SHIELD.

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The ancient rapakivi-like granites of the Baltic Shield (2760±30 Ma, Pb-Pb method at zircon) form some massifs in the north-eastern and central parts of the Kola Peninsula by the area of 500 km^2. The post-tectonic intrusives have been located along the large fault zones and were of more later origin than the massifs of the gabbro-anorthosites, and zones of fine-grained granites of the granophyre texture are formed in the margins of the granite massifs. The rocks by their chemical composition are subalkaline or normal granites and leucogranites are near to the typical rapakivi granites of the Baltic Shield. The sequence of the mineral crystallization is the following: plagioclase + ferrosalite(F=67) + ferrohastingsite (F=90-96)-K-Na feldspare (phenocrysts)+ ilmenite - K-Na feldspare (the bulk of crystals)+quartz+lepidomelane(F=89-93)+zircon+sphene+allanite. The massif formation occured on the depth

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