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BURIAL AND HYDROTHERMAL DIAGENESIS OF THE SANDSTONES IN THE EARLY MESOZOIC DEERFIELD RIFT BASIN, MASSACHUSETTS

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ABSTRACT: The burial and hydrothermal diagenesis that affected the sandstones in the Deerfield rift basin is interpreted using field mapping, thin-section modal analyses, X-ray diffraction, SEM imaging, microprobe analyses, $^{40}Ar/^{39}Ar$ thermal analyses of individual detrital microcline crystals, and biomarkers. During burial diagenesis, albite and quartz overgrowths were ubiquitous early cements, co-precipitated from downward-circulating groundwaters driven by topographic relief around the basin. Beginning about 201 Ma, in earliest Jurassic time, increased rates of crustal extension led to melting of the upper mantle and extrusion of the Deerfield lavas. High heat flow due to crustal extension peaked at about 184 Ma, producing a deep-basinal, hot brine. Soaking in the brine and rising hydrothermal plumes generated four patterns of diagenetic minerals superimposed on the early burial cements: illite; mosaic albite; bleached mosaic albite; and chert-illite-pyrite. Biomarker data show that the lacustrine gray/black mudstones are thermally overmature for hydrocarbons, in and beyond the "gas window."

Argon spectra for detrital microclines in the Sugarloaf Arkose are compatible with gradual cooling of the basin through about 150/C at about 170-150 Ma. The spectra also indicate cooling through 300-350/C at 290-270 Ma, confirming Late Paleozoic metamorphism of the Lower Paleozoic source rocks east of the basin.

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THE OCCURRENCE OF STRONTIANITE AT HIGH POINT, ALBANY COUNTY, NEW YORK

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ABSTRACT: A new occurrence of strontianite has been identified approximately 20 kilometers west of Albany, New York, within the Helderberg escarpment at High Point. The strontianite exists in a 5 to 13 cm thick layer of tectonized limestone. The layer rests between the underlying Brayman Shale and the micro-laminated Rondout Dolomite. Electron probe analysis yielded the mineral formula $(Sr_{(0.84)}\ Ca_{(0.16)}\ CO_3)$. X-ray results using a powdered mineral sample were used to calculate cell parameters: a=5.086Å, b=8.342Å, c=5.988Å, yielding a calculated mineral density of 3.664g/cm^3. Stained petrographic thin-sections of the strontianite layer reveal a texture and mineral assemblage with little resemblance to the units immediately above and below.

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SHAKESPEARE GOT IT WRONG. IT'S NOT "TO BE", IT'S "TO DO"!: THE AUTOBIOGRAPHICAL MEMOIRS OF A LUCKY GEOPHYSICIST: PART 3

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[a preview]

CHAPTER SEVEN ANCESTORS, PARENTS, AND FAMILY

The Ertle Side

From the age of two until I left for college at age seventeen, I resided with my family at 316 Ertle Avenue in Massillon, Ohio. That the name of that street is also my middle name, and my mother's maiden name, is no coincidence. My great grandfather, Martin Ertle, was an early settler in Massillon. He acquired a substantial piece of property which he later parceled out to his descendants. Those of my mother's generation received a building lot, and much of the street, Ertle Avenue, which was of course named after Martin, was inhabited by cousins of one kind or another who had also received a lot. It was an Ertle neighborhood.

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EVIDENCE FROM CATSKILL PEDOGENIC CARBONATES FOR A RAPID LATE DEVONIAN DECREASE IN ATMOSPHERIC CARBON DIOXIDE CONCENTRATIONS

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ABSTRACT: Carbon isotopic data from calcitic pedogenic nodules in Catskill redbeds in south-central New York suggest that atmospheric PCO_2 in the Middle to Late Devonian was 7 to 16 times that of today, but was decreasing faster than previous data and models have indicated. These data come from micritic and/or microsparitic portions of rhizocretionary nodules, whereas data from diagenetic spar in nodules, gleyed nodules, nodules with any depositional carbonate, and bedded carbonates were excluded. The mean $\delta^{13}C$ of the Givetian nodules is -6.61‰ vs. PDB, whereas the mean $\delta^{13}C$ of the slightly younger Frasnian nodules is -7.93‰ vs. PDB. Application of Cerling's (1992) paleobarometer to these data indicates that atmospheric CO_2 concentrations decreased from a range of 2900 to 5200 ppmV in the Givetian to 2300 to 3200 ppmV in the Frasnian. These results suggest that atmospheric CO_2 dropped rapidly in the Late Devonian, perhaps causing global cooling

that led to South American glaciation and that contributed to Late Devonian extinction. The results also suggest that PCO_2 changes alone cannot account for the observed temporal variation in the mineralogy of abiotic marine carbonates.

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CARBONATE DIAGENESIS AND DOLOMITIZATION OF CAMBRO-ORDOVICIAN (SAUK SEQUENCE) PLATFORM STRATA IN CENTRAL NEW YORK: DEPOSITIONAL ENVIRONMENTS, PARASEQUENCES, AND FACIES

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ABSTRACT: The Cambro-Ordovician platform carbonates exposed on the Saratoga Platform in central New York record a complex diagenetic history ranging from early peritidal dolomitization to late-diagenetic, deep-burial dolomitization. Stratigraphically, this sequence is distinguished here as the Upper Cambrian Little Falls, Galway and Hoyt formations and the Lower Ordovician Gailor and Tribes Hill formations.

Outcrop studies reveal that the bulk of this sequence has been dolomitized. The Little Falls and Galway formations are composed of interbedded dolostones and sandstones that display herringbone cross strata, planar and domal stromatolites, intraclasts, bird's eye structures, and local chert horizons. The Hoyt Formation is extremely fossiliferous; it contains columnar, domal and planar stromatolites and trilobites. The younger Gailor and Tribes Hill formations display planar stromatolites, chert horizons, storm beds, dissolution-collapse breccia, and bird's eye vugs, the strata becoming increasingly fossiliferous towards the top. The post- Sauk, pre-Tippecanoe surface of unconformity lies atop the Lower Ordovician strata. A peritidal environment of deposition is inferred for the entire sequence.

The facies study of these Sauk Sequence carbonates, shows that an aggrading pattern of multiple meter-scale, upward-shallowing, parasequences developed, during a period of regional transgression.

Transmitted-light and cathodoluminescence petrography have revealed seven different dolomite generations, which differ from one another in terms of their crystal size, luminescence, trace- element content, and stable-isotope compositions. Four stages of dolomitization are recognized in the rocks under study. The first stage is considered to have occurred early in the diagenetic history, when microcrystalline Dolomite (1) and fine-crystalline mosaics of Dolomite (2) formed during and immediately following deposition. The second and main stage was one of massive dolomitization that occurred in the subsurface during progressive burial and involved multiple episodes of textural and geochemical change, resulting in Fe- and Mn-rich, zoned, medium- to coarse-crystalline, planar-e to

planar-p Dolomite (3) and nonzoned, xenotopic, medium- to coarse-crystalline mosaics of Dolomite (4). The third stage was one of uplift of the basin, when Fe-poor, meteoric fluids entered the strata producing bright, orange-luminescent Dolomite (5) cements. The fourth and final stage of dolomitization occurred in the deep subsurface, where subsurface brines precipitated Fe-rich Dolomite (6) (saddle dolomite) and Dolomite (7) cements in vugs.

Compared to the early-diagenetic dolomites, the late-diagenetic dolomites are: (1) more stoichiometric; (2) coarser; (3) more depleted in $\delta^{18}O$ and Sr^{2+} ;(4) more enriched in Fe^{2+} and Mn^{2+}. These geochemical differences imply that early dolomite generations formed from modified seawater in the depositional environment and soon after, whereas later-formed generations of dolomite formed by:(1) recrystallization or neomorphism of early formed dolomite; (2) replacement of limestone at elevated temperatures; and (3) cementation in fractures and secondary pores.

The dolomite fabrics are intimately associated with products of other diagenetic events, such as silicification, dedolomitization, stylolitization, and cementation by burial calcite. The diagenetic sequence, that we have reconstructed in the platform strata is remarkably similar to that worked out by Guo (1994) and by Guo, Sanders and Friedman (1996) in the coeval rocks of the Appalachian fold-thrust belt exposed in eastern New York. This implies that the burial histories of the Sauk Sequence from these contrasting tectonic provinces, Saratoga Platform on the west and the Appalachian fold-thrust belt on the east were comparable.

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