MAGNESIAN CALCITE STABILITIES IN AQUEOUS SOLUTION: CONTRASTS IN RESULTS FROM DISSOLUTION OF BIOGENIC AND SYNTHETIC PHASES AND BIOGENIC PRECIPITATION

№ 62353

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Dissolution studies were performed on a series of biogenic and synthetic (prepared at high temperature and pressure) Mg - calcites to evaluate their stabilities in aqueous solution at 25 °C. Synthetic phases with $MgCO_3$ concentrations below 4 mole% are more stable, whereas those with higher concentrations are less stable than calcite, with stability smoothly decreasing as a function of composition. These results are similar to previous experiments involving inorganic precipitation of Mg - calcite. Biogenic samples are less stable than synthetic phases, and the stability decrease does not vary smoothly with composition. For the biogenic materials, those with compositions greater than 11-13 mole% $MgCO_3$ are less stable than aragonite.

The composition of skeletal Mg - calcite precipitated by the coralline alga Porolithon gardineri in environmentally controlled seawater was measured as a function of temperature, available light, and saturation state. Saturation state is the most important factor that determines Mg concentration. In contrast to dissolution experiments, only small differences in Mg concentration are observed for large changes in saturation state. The concentration of $MgCO_3$ in the precipitated material ranges from 15 mole% at a stoichiometric ion activity product (IAP) equal to calcite saturation to 19.5 mole% at an IAP approximately seven times the saturation of calcite

RIETVELD REFINEMENT OF THE CRYSTAL STRUCTURES OF TODOROKITE, ROMANECHITE, AND CORONADITE*

№ 67257

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The Mn-oxide minerals todorokite, romanechite, and coronadite are geologically and economically important, but their structures are not well known because the minerals are massive and yield x-ray powder diffraction (XRD) patterns with broad, poorly-defined reflections. The romanechite structure was solved from two-dimensional single crystal x-ray data (Wadsley, 1953), but the todorokite and coronadite structures have not been refined. Controversy exists over the todorokite structure, and both layer and tunnel structures have been proposed. We refined the structures of these minerals using the Rietveld program DBW 3.2 (Wiles and Young, 1981) and XRD data. Our refined structure of romanechite from Van Horne, Texas, agrees well with that determined by Wadsley. Electron density maps show that Ba is not at y=0.0 as determined by Wadsley but is displaced ~0.3Å off the mirror plane and exhibits anisotropic thermal motion along the tunnel axis. The refined structure of coronadite from Broken Hill, Australia, is close to those determined by single crystal methods for other hollandite minerals (e.g. cryptomelane). Pb is displaced off the special position, (0,0,0), to (0,0.2,0), similar to the Ba displacement in other hollandite compounds. Our refinement of todorokite from Charco Redondo, Cuba, confirms the 3X3 tunnel structure proposed by Turner (1982) and provides information on the positions of the tunnel cations. Best results were obtained with the tunnel electron density (Na, Ca, H_2O) located at (0.68,0.5,0.33). For all three structures, oxygen positions were determined with relatively poor precision, but our data show that valuable structural information can be obtained for minerals yielding XRD patterns with broad, overlapping peaks.

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CORRELATION OF HYDROTHERMAL SERICITE COMPOSITION WITH PERMEABILITY AND TEMPERATURE, COSO HOT SPRINGS GEOTHERMAL FIELD, INYO COUNTY, CA

№ 60572

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Petrographic and geochemical analyses of cuttings from six wells in the Coso Hot Springs geothermal field show a systematic variation in the occurence, texture, and composition of sericite that can be correlated with high permeability production zones and temperature. The wells studied intersect rhyolitic dikes and sills in the fractured granitic and dioritic basement rocks which serve as the reservoir for the geothermal system. Low-permeability non-productive zones in the wells contain coarse-grained compositionally homogeneous primary muscovite. High-permeability production zones are characterized by abundant fine-grained hydrothermal sericite that exhibits a systematic increase in K and Al and decrease in Si with increasing temperature. Hydrothermal sericites from producing zones with measured temperatures of 215°C, 236°C, and 250°C also show a consistent increase in Mg and Fe.

Calculated activities of the muscovite ($KAl_2(AlSi_3)O_{10}(OH)_2$) and pyrophyllite ($Al_2Si_4O_{10}(OH)_2$) components for the hydrothermal sericites increase and decrease, respectively, with increasing temperature. This trend is similar to that reported for geothermal systems at Roosevelt Hot Springs and the Salton Sea, although sericites from these systems are compositionally distinct from those at Coso.

Computed distribution of aqueous species in the geothermal fluids were combined with activity phase diagrams accounting for hydrothermal sericite compositions to determine a pH of 6.1 for the geothermal fluids. These calculations suggest that hydrothermal sericites are in local equilibrium with the geothermal fluid, but primary muscovites in low permeability zones are metastable. Compositional data on hydrothermal sericite from active geothermal systems at Coso Hot Springs, Roosevelt Hot Springs, and the Salton Sea show that the mineral is sensitive to temperature and water/rock ratios and may be a useful indicator of high permeability zones within a geothermal field.

LATE-CENOZOIC STRATIGRAPHY AND TECTONIC EVOLUTION WITHIN A SUBSIDING BASIN, SOUTH-CENTRAL WASHINGTON

№ 70805

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Sediments overlying Miocene basalt record aggradation, degradation, and relative tectonic movements within the central Cold Creek syncline, a basin with a long history of subsidence. Seven lithofacies were found to correlate among 40 boreholes over an area of ~80 km^2; five belong to the Neogene fluvial-lacustrine Ringold Formation: (1) a quartzitic, conglomeratic sand overlain by (2) fine-grained fluvial facies capped by a well-developed paleosol, collectively referred to as the basal Ringold. Next, laminated mud (3) accumulated slowly in a low-energy environment (lower Ringold). Quartzitic, braided stream gravels (4) of the middle Ringold were deposited next when the main channel of the ancestral Columbia reoccupied the study area. A sudden, regional transition from conglomerate to (5) fine-grained facies (upper Ringold) is interpreted to reflect upstream changes in either climate or tectonic activity, which altered sediment supply and stream gradient. Incision, due to a regional base level drop ~3 m.y.B.P., removed part or all of the upper Ringold. Other correlative units include: (6) locally derived Pleistocene(?) detritus that filled a paleochannel near the synclinal axis; pedogenic calcrete developed, coevally, adjacent to this channel and (7) late-Pleistocene cataclysmic flood deposits that blanket the study area.

Subsurface lithostratigraphic correlations generally corroborate a model for long-term, low-average rate of tectonic deformation. Structure contour and isopach maps suggest syndepositional folding resulted in nearly continuous aggradation and preservation of sediments during Ringold time. The history of deformation after post-Ringold surfaces is less clear because of erosion. Subsidence may have accelerated temporarily during middle Ringold time, as indicated by the thick conglomeratic sequence which is significantly warped at the base but not on top.

A NEW BOUGUER GRAVITY MAP FOR NORTH CAROLINA

№ 78916

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About 10,600 gravity stations have been used to create a revised gravity map. The map shows a close correspondence with surface geology and magnetic maps.

A steep gradient occurs between the volcanic Carolina slate belt (CSB), which has extensive mafic roots, and the felsic rocks of the Grenville Sauratown Mt block. To the southwest, a much shallower gradient results due to the intervening Charlotte belt and suggests the absence of significant older felsic crust in the south-central Piedmont. The CSB, a flat positive, is interrupted by a structurally transverse E-W anomaly.

The Coastal Plain (CP) and continental shelf show a gentle rolling surface similar to the Charlotte belt's. The entire map is occasionally cut by shallow circular anomalies which coincide with granite plutons where exposed. An extensive negative anomaly is centered on the Rollesville pluton, another large one is presumably buried under the CP in the vicinity of Lumberton. Others show under the CP and several anomalies have been drilled, encountering granites. The Raleigh and eastern slate belt as well as the various Triassic basins show little effect on the regional trend and thus must be relative minor structural blocks.

Thrust sheets in the Blue Ridge are defined by large irregular negative anomalies with shallow amplitude superimposed on the highly negative regional values. The Kings Mt belt in NC is delineated by a coincidence of contour lines with its boundaries. The Brevard zone in northern SC produces pertubations of crosscutting contours but has no significant effect to the north.

CONCENTRATION VARIATIONS OF AMINO ACIDS IN MAMMALIAN FOSSILS: EFFECTS OF DIAGENESIS AND THE IMPLICATIONS FOR AMINO ACID RACEMIZATION ANALYSIS

№ 63[illegible]

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Detailed amino acid analysis of bones, teeth, and antler from several mammal species have shown that concentrations of several amino acids can be related to three factors: type of material analyzed, diagenetic alteration of the material, and relative age of the fossil.

Concentrations of several amino acids are significantly different in enamel compared to those of dentine or cement. This can be used to check that no contamination of one material by another has occurred, which is critical for using the data for amino acid dating since all three materials have different racemization rates for some acids. Furthermore, comparative ratios between different acids (called interacid ratios) reflect similar differences.

With increased ingrowth of secondary minerals, generally reduced amino acid concentrations are observed. Interacid ratios and concentrations vary significantly the norms expected for the type of material with increasing degrees of alteration. These effects can be linked to abnormal racemization ratios observed in the same samples.