Characterization of carbonate mineral formation by cyanobacteria and the implications in CO_2 sequestration

R.E. MARTINEZ, O.S. POKROVSKY, J. SCHOTT AND E.H. OELKERS

LMTG-OMP, Université Paul Sabatier, 14 av. Edouard Belin, 31400 Toulouse, France (raul.martinez@lmtg.obs-mip.fr)

Biomineral-fluid reactions, including dissolution, adsorption, nucleation, and precipitation minerals are key to solving pressing issues such as minimizing the risk of groundwater extraction, optimizing CO_2 sequestration, safe storage of radioactive waste products, and minimization of pollutant transport. Current understanding of the biomineral-fluid interface is only fragmentary. Although we have a good understanding of the reactivity of minerals in abiotic systems little is known about the kinetics and thermodynamics of biomineral fluid reactions. The major limitation of past biomineralization kinetic studies performed in batch reactors to quantify reaction rates is that it is not possible to control many rate influencing parameters, such as pH, solution saturation state, and bacterial activity and biomass. As such it is impossible 1) to determine the effect of each of these rate influencing parameters individually and thus 2) develop robust equations that can be applied to describe these rates in natural systems. These limitations were overcome in the present study by the modification and application of mixed-flow reactor systems to biomineralization

Results from *Synechococcus sp.* photosynthetic cyanobacteria in supersaturated calcium carbonate systems presented are used to determine *steady-state* thermodynamic and kinetic parameters for the development of macroscopic models capable of predicting carbonate bio-mineralization rates as a function of bacterial cell activity/metabolism, biomass, temperature, pH, and pCO_2.

Different plutons, the same feeding zone

H.C.B. MARTINS, H. SANT'OVAIA AND F. NORONHA

GIMEF, Geology Dep./Geology Center, Porto University, Portugal; (hbrites@fc.up.pt; hsantov@fc.up.pt)

Multidisciplinary studies integrating petrography, geochemistry, anisotropy of magnetic susceptibility (AMS) studies and gravimetry were carried out on Vila Pouca de Aguiar (VPA) and Águas Frias-Chaves (AF) porphyritic biotite granite plutons which distance *ca* 20 km one from the other. These plutons are spatially related to Penacova-Régua-Verin fault (PRVF), a late Variscan fault, which belongs to the NNE-trending brittle system that crosscuts the whole of Northern Portugal. VPA pluton is zoned and composed by two main facies: a peripherical biotite-rich medium-grained monzogranite (VPA granite) and a central medium- to fine-grained leucogranite. The AF granite pluton it is composed by a marginal coarse-medium grained cordierite-bearing monzogranite (AF granite) and by a central two-mica medium-grained granite.

The modelling of the residual gravity indicates that the shapes from the two granite plutons are quite different: (i) VPA pluton is laccolithic in overall shape, less than 1 km in thickness on 60% of its thickness area; (ii) AF pluton has a greater thickness (≈10 km) and is a thicker and deeply rooted body. However gravity data shows a connection of the two gravimetric anomalies. Assuming this connection, a possibility of a relationship between the two plutons was investigated. AMS studies yield magnetic susceptibility averages of 101.0 E^{-6} SI to VPA pluton and 80.7 E^{-6} SI to AF pluton. The magnetic anisotropy are quite low and similar, 1.4% to VPA pluton and 1.6 % to AF pluton, confirming their classification as late orogenic (post-tectonic) plutons wich agrees with field data.

The studied granites are sligtly peraluminous monzogranites, 1.02<ASI<1.07, and have similar geochemical features (major, trace and REE). However biotite compositions are quite different, namely in content of octahedral Al and XMg wich are higher in AF granites. The tipology features of biotite from VPA granite indicates a sub-alkaline affinity while the biotites from AF granite suggest a aluminopotassic signature, wich are in agreement with the presence of cordierite. These features, the mantle-like isotopic data (Sr_i= 0.704-0.707 and εNd=-1.98 to -2.5) and the available $\delta^{18}O$ (+10 to +11) led us to propose a model of mantle input followed by mantle crust interactions for the origin of these granites, although implying a major crustal contribution for AF granite.

We propose the PRVF as the same feeding zone for the two plutons This fault is also a preferential location for several CO_2 rich thermal water springs, that reach temperatures of 74°C near AF pluton, at Chaves, while in VPA pluton temperature is much lower, 15°C at Pedras Salgadas. A deeper circulation explain the hotter water from Chaves spring, wich is consistent with a deeper root and a thicker shape for AF pluton than for VPA pluton.