B and Sr isotope variations induced by (hydro-)thermal effects on pelites

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$\delta^{11}B$ and Sr isotope ratios were measured (Figure 1) in metapelitic samples collected at increasing distances from: A) Mt. Capanne monzogranite pluton and B) Capo Bianco laccolith (Elba Island, Italy). In transect A, pelitic rocks were thermometamorphosed in the horneblende hornfels facies, with limestone layers deeply replaced by garnet and diopside. In transect B, pelites were sericitized and silicified up to 7 meters from the contact.
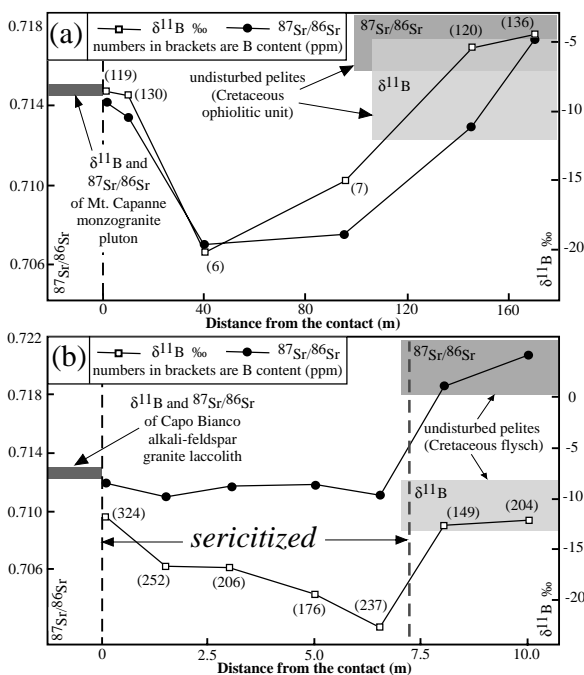

Figure 1: B and Sr isotopic variations and boron content of metapelites from transect A (a) and B (b).

In transect A the host rocks lost a large amount of their absorbed, and also structurally bonded, boron leaving a B-depleted pelitic hornfels with negative $\delta^{11}B$. Sr ratios also suggest an important redistribution of the carbonate component. In the late magmatic stage, metapelites near the contact interacted with B-rich, exsolved, fluids and their $\delta^{11}B$ and Sr ratios approached the granite values. In transect B, very negative $\delta^{11}B$ might be explained by the strong hydrothermal sericitization of smectites controlled by B-rich fluids exsolved from the laccolith. Therefore, in spite of the negative $\delta^{11}B$ signature displayed by many anatectic granite systems, (hydro-)thermal processes, involving pelites, could produce high $\delta^{11}B$, B-rich, crustal fluids like those observed in some geothermal fields.

Diagenetic Modelling of Anaerobic Lake Sediments

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Reading Sediment and Lake History with Models

Sediment records provide lake-specific background data as well as information about their ecological development. However, post-depositional biogeochemical reactions, migration and mixing by benthic organisms can obscure these signatures in time series. A quantitative interpretation of sediment profile requires the separation of biogeochemical processes from trends in sediment deposition. In this situation, dynamical diagenetic modeling can be helpful.

Diagenetic Model of Lake Sediments

In this paper we present a dynamic model of early diagenetic processes. This one-dimensional, multi-component model based on transport reaction equations accounts for the coupled reactions among the major redox and acid-base elements O, C, H, N, P, S, Mn, Fe and Ca. It incorporates kinetic descriptions for the microbial degradation pathways of organic matter and precipitation-dissolution reactions. Local equilibrium applies to fast homogeneous reactions only. The model equations were implemented in the computer program AQUASIM (http://www.aquasim.eawag.ch), designed for simulation and data analysis of aquatic systems.

Eutrophication of Lake Zug

We illustrate how this model can be applied by examining the influence of eutrophication on the accumulation of different components in the lake sediment. Lake Zug is a deep hard water lake with a dramatic eutrophication history over last 100 years. We calculated profiles of iron sulfides over two hundred years assuming an eutrophication scenario. Eutrophication was simulated by time dependent boundary conditions of oxygen and nitrate concentrations and fluxes of organic matter and calcite. The simulations showed that the accumulation of iron sulfides in the sediment begun simultaneously with the eutrophication of Lake Zug. The model allowed a comprehensive description of the data set collected for sediment of the eutrophic Lake Zug.
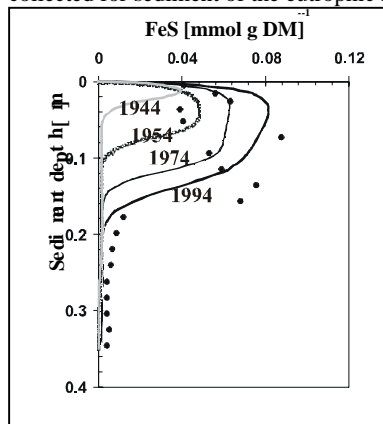

Figure 1: Concentrations of FeS in the sediment of Lake Zug.