ISOTOPIC EQUILIBRIUM/DISEQUILIBRIUM IN MIGMATIZATION: AN EXAMPLE FROM THE LIMPOPO BELT, BOTSWANA

V. CHAVAGNAC, J. D. KRAMERS

Gruppe Isotopengeologie, Universität Bern, Min. Petrol. Institut, Erlachstr. 9a, 3012 Bern, Switzerland

Since the eighties, several obvious cases of disturbance of the Sm–Nd system during intracrustal processes such as metamorphism and partial melting have been found implying that Sm–Nd model ages are often not meaningful as protolith ages. Therefore, it is important to understand what controls Nd isotopic equilibrium on a centimetre scale during such processes. From this perspective we present geochemical as well as Nd and Pb isotopic data on a migmatitic sample from the Central Zone of the Limpopo Belt, Botswana. This sample was cut into 4 pieces of several centimetre size. In order to test the Nd and Pb isotopic equilibrium, we took one piece representing very well interlayered leucosome, melanosome and palaeosome. It would be expected that the leucosome should portray the partial melt. However, the REE pattern of leucosome is LREE depleted compared to the REE patterns of melanosome and palaeosome. These unexpected REE patterns may be explained by the behaviour of accessory minerals such as apatite, monazite or zircon which mainly control the REE as well as the Th and U budget of a rock. Thus their partial or total dissolution during a high-grade metamorphic event will strongly affect the REE contents of each migmatitic components. If Nd isotopic equilibrium was reached during migmatization, the leucosomes would yield too old T_{DM} ages, and those of melanosomes would be too young. However, the Nd isotopic compositions indicate that no Nd isotopic equilibrium is attained in migmatization. The ε_{Nd} values at 2.0 Ga (the age of the high-grade event) differ by more than 1 ε unit between these parts. Moreover, the U–Pb isotopic compositions on the same fragments yield a Pb–Pb isochron of 1998 ± 68 Ma (MSWD = 0.65; 6 points) indicating that Pb isotopic equilibrium was reached. All migmatitic components are well above the Stacey and Kramers curve which suggests a long crustal history prior to 2.0 Ga.