Geohygrometry of K-feldspars

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Microclines from the Aar metagranite (Swiss Alps) were analysed by a number of isotopic and microchemical techniques in order to understand their Ar retentivity.

Staircase-shaped ^{39}Ar-^{40}Ar age spectra can be modelled by considering ^{39}Ar as the only isotope of interest, following conventional 'thermochronology'. However, overdetermined independent paleothermometry constrains the peak T quite reliably to 430-450 °C and apparently implies that the mylonite zone was active for less than a year. This leads to a geologically unrealistic slip rate. Instead, multiple isotope systematics (Pb and Sr stepwise leaching, ^{37}Ar/^{39}Ar and ^{38}Ar/^{39}Ar ratios) reveal that two diachronically grown K-feldspar generations coexist: Kfs-1 ($\geq$ 35 Ma old, Cl-poor, Rb-Ca-rich, low ^{87}Sr/^{86}Sr, high ^{206}Pb/^{204}Pb) and Kfs-2 ($\leq$ 10 Ma old, antithetic isotopic signatures deriving from external fluids). Staircase spectra are observed to reflect mixing of distinct feldspar generations rather than within-grain diffusive gradients. Kfs-1 retained its chemical and isotopic signature at 450 °C.

Chemically heterogeneous microtextures were imaged by cathodoluminescence and element mapping by electron microprobe. Quantitative microanalyses confirm *hetero-chemical replacement* (cfr. Parsons, this meeting), such as the addition of water-soluble Ba transported by a fluid. This combined strong chemical and microtextural evidence argues for fluid-dominated recrystallization. Our ability to date and to characterise the P-T-A-X of fluid events depends in an essential way on taking into account petrogenesis and multi-isotope geochemistry. The stepwise release of Ar, Pb and Sr must not be modelled as diffusion from a single inert matrix. Arrhenius rates reflect a sum of unrelated processes, and therefore lead to inconsistencies when extrapolated to geological times. What feldspars can be used for is to constrain the fluids that interacted with them by multi-isotopic analyses, rather than to model a 'cooling history' from ^{39}Ar release alone ignoring microtextures.

Effects of seawater alteration on the ^{234}U/^{238}U-ratios of mid-ocean ridge basalts

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After having been formed at mid-ocean ridges, oceanic plates cool as they move away from the ridges and become older. Much of this cooling is related to hydrothermal alteration by seawater infiltrating the plates. During seawater-rock interaction, primary minerals are transformed into secondary minerals, influencing the bulk rock composition.

Two processes mainly control element abundances in the oceans: continental weathering and hydrothermal activity in the oceanic plate. The hydrothermal activity is further divided into high-T (near ridge) and low-T (off the ridge) alteration. High-T alteration processes can be easily studied in hydrothermal vent regions. As low-T alteration processes in the oceanic crust are rather diffuse and slow, their limits and conditions (time, temperature, etc.) are largely unknown and thus investigation of off-ridge alteration is important. This study investigates the alteration processes of mid-ocean ridge basalts (MORB) in the low-T environments and constructs a time frame for seawater-rock interaction in these regions.

Weathering of the continental plates keep the U-serie decay chain in the ocean in disequilibrium (a ^{234}U/^{238}U-ratio of ~1.14). On the otherhand, MORB formed at the ridge are in secular equilibrium. Thus any seawater alteration of MORB leeds to an enriched ^{234}U/^{238}U-ratio. After ~5 half-life times the MORB are again in secular equilibrium. Prelimiary ^{234}U/^{238}U-data on old oceanic crust from ODP Site 1179 (~129Ma) and ODP Site 843 (~94Ma) shows that altered MORB are in secular equilibrium. Nevertheless, higher U concentrations in the altered MORB compared to fresh MORB on both Sites suggest that seawater alteration occurred earlier, but outside the radiogenic detection window of ~1.25Ma for the ^{234}U/^{238}U decay chain. Additional U-series measurements on altered MORB from younger ODP Sites are currently in progress.