A K-Ar age reset of frictionally melted gabbro and detect for degassed noble gas

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Radiometric age is defined as a cooling age or a closure age of a particular mineral or of minerals. With determination, quantitative analysis of thermal history of a rock or a geologic event (fault movement) could be performed with comparison of various minerals of radiometric age. Contrastingly, other method, e.g. ESR, FT and U-He age, the closure temperature of K-Ar system is rather high, a kind of melted-rocks under more high temperature, such as pseudotachylytes, are widely applied to evalution of fault activity with K-Ar dating method. To obtain reliable ages of fault activities, it is a key issue whether the ages were initialized by re-equilibrating their Ar isotopes with atmospheric Ar besides to be rejuvenesced, and other noble gas isotopes are re-equilibrating from original rock ratio to atmospheric ratio. In the case that such a rejuvenescence can explicate one of a geochemical phenomena of field observation, analyses of apparent K-Ar ages could be applied for fault rocks for thermal history.

Here we report a preliminary experiment that effectuates high temperature frictional melting experiments with using a high-velocity friction apparatus in Kyoto Univ. in order to test whether age is reset by frictional heating of fault or not. A pair of gabbro chunks cut into hollowed cylinder was slid at a slip velocity of 1.3 m/s and a normal stress of 1.4 MPa. Under this condition, local frictional melting started into 5 sec. and temperature around an artificial fault reached around 1100 C in ca. 20 sec., then fault plane is well above the closure temperature of K-Ar system. Due to rapid equilibrium of volatiles during frictional melting of rocks, we expect that the K-Ar age should be reseted. This age-reset is only observed in glass completely melted. In natural field observation, such completely melted glassy materials, are faced on fault planes. Such glassy materials age are regarded to be reset during fast fault movement by re-equilibration of Ar isotopes to atmospheric one at the event. An apparent incomplete initialize was observed in the part including some un-melted gabbro fragments. In the part, mechanically fractured pieces are mixed in the glass matrices in frictional zones. That's why the Ar isotope ratios might not be re-equilibrated in the experiments. However, U-He age is also initialized as for re-equilibration of He isotopes, which is more sensitive and degassed earlier than Ar isotopes such as low speed frictional and low temperature (un-melted), just crushed rock.

Sulfur/Selenium ratios in Bushveld Complex, South Africa

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Introduction

Over the past decade S/Se ratios have been used in modeling the processes leading to magmatic ore deposits. Sulfur and selenium have many chemical similarities but the use of S/Se ratio is based on the idea that Se is less mobile. Thus, magmatic sulfides ore deposits have S/Se ratio close to mantle values (~2500-4000). If sulfides are altered S may be preferentially removed resulting in rocks with low S/Se.

It has been suggested that the Pt-rich Merensky Reef in the Bushveld Complex formed when Pt-bearing disseminated sulfides in the underlying cumulate rocks were dissolved by Cl-rich fluids. The S and Pt were deposited at the level of the reef when this fluid dissolved into the intercumulate silicate liquid. An alternative model for the formation of the reef is that sulfides segregated from the mafic magma a little above the reef then collected on the cumulate pile. We have investigated these models with the idea that if the Pt and S were collected from bellow the reef then the S/Se ratios of the cumulate pile should be less than normal magmatic values and S/Se ratios in the reef should be higher than magmatic values. Alternatively if the sulfides in the reef segregated from a mafic magma they will have S/Se ratios close to mantle.

Results and conclusion

The S/Se ratios of the reef rocks is approximately 2000 and the S/Se ratios of the rocks below the reef are in most case >2000, within or close to S/Se mantle range (Fig. 1). Therefore S/Se ratios are consistent with the magmatic model for the formation of the reef.

Figure 1: Statigraphic distribution of S/Se ratios in Bushveld (Union section)