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A technique for calculation of accurate exhumation rates for UHP rocks: Rb/Sr isotope analyses of the CCSD eclogites (Sulu, China)

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In order to constrain mechanical models for the exhumation of UHP rocks, the most challenging parameter to obtain is probably the rate of this process. In principle, this can be achieved by dating successive segments of the retrograde P-T trajectory of the UHP rocks considered. Numerous studies on the Dabie-Sulu orogen have been dedicated to deciphering the P-T paths of the UHP rocks. However, if the general shape of the P-T path is now well established, a wide range of exhumation rates have been calculated. This is because the exact timing for the closure of a radiochronometer in the retrograde course is difficult to establish because of the large number of parameters that possibly control this process.

A key question is: do the dates obtained represent cooling or recrystallization ages? In the first case, age interpretation would rely on the closure temperature theory (Dodson, 1973). Fortunately, eclogite samples from the Chinese Continental Scientific Drilling (CCSD) borehole at Donghai (Sulu Belt, China) provide us with a unique opportunity to test the closure temperature concept. Our sample set comprises ten eclogites selected from the first 2000 m core transect. All the eclogites recorded the same P-T path, but are characterized by a wide variety of modal and chemical compositions, as well as granulometry. The closure temperature theory expects that grain size, modal composition and chemical composition of the mineral phases would control the temperature at which a radiochronometer is set to function during cooling. Therefore, the comparison of geochronological data obtained for a given isotopic system applied to the same mineral species in the 10 samples should provide an excellent test for this

concept.

Rb/Sr dating was first performed on phengite fractions from six phengite-bearing eclogites. The results indicate a probable correlation between Rb/Sr ages, granulometry and modal composition. At first appearance, two groups of ages were obtained for two groups of eclogites with contrasting granulometry. Two eclogites with the mean grain size of $\sim$1 mm gave Rb/Sr dates of 228 $\pm$ 3 Ma and 230 $\pm$ 3 Ma, whereas four eclogites with the mean grain size of $\sim$200 μm provided Rb/Sr dates between 197 $\pm$ 3 Ma and 220 $\pm$ 3 Ma. Then, in a single group, Rb/Sr age values decrease with increasing apatite/phengite ratios (apatite being the main reservoir of Sr and therefore the principal partner for isotope exchange with phengite). This correlation is in perfect agreement with the closure temperature theory. Our ultimate goal is to establish numerical relation between geochronological data and the factors influencing closure temperature (e.g. modal composition, grain size, chemical composition). This should allow us to calculate precise closure temperature for a given clock in a given sample by modeling and then to deduce accurate cooling and exhumation rates. This work is being completed with more Rb/Sr dating on phengite, and supplemented by Sm/Nd dating on garnet and U/Pb dating on zircon.