Geophysical Research Abstracts, Vol. 9, 08639, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08639

Zircon growth: insights from shape studies

F. Guillot and S. Lasalle

Univ. Lille, Sciences de la Terre & CNRS, UMR PBDS – F-59650 Villeneuve d’Ascq , France
(francois.guillot@univ-lille1.fr)

We have sorted by size the zircons extracted from Frasnian K–bentonites (in order to create size fractions for U–Pb dating: cf. 2 other abstracts by Lasalle *et al.*). Zircon shape and zircon size were recorded together systematically, for several hundredths of crystals of each level. Spreadsheets were designed for recording data, establishing statistics of size and of shape, and checking correlations in-between. Here we infer petrological considerations from this database.

We deal here with three Frasnian K–bentonites, L3 and L6 from the Lion quarry (Belgium – N 50˚4’17.12", E 4˚30’38.67"), and SS from the Steinbruch Schmidt quarry (Germany – N 51˚05’12.34", E 9˚07’54.04"). The smallest separable grains were at 32 μm and no zircon greater than 125 μm (mesh size) was found. The zircon abundance is $\leq$ 0.03 wt %. Regarding the distribution by size, the number of crystal and their mass decreases when the mesh size increases, following an apparently exponential law: typically, 50 % of zircon mass falls into the 32-63 μm size range, while no zircon remains over 125 μm. Zircon crystal shape statistics were established with the help of scanning electron microscopy imaging. Using the shape nomenclature of Pupin (1980, Contrib. Min. Petr.), each of the three K–bentonites contains distinctive types of zircon shapes attributable to: (L3) a mildly alkaline rhyolite at 850–900˚C; (L6) a highly-alkaline rhyolite at 750–850˚C; (SS) a calc-alkaline magma at 650–750˚C.

SS and L6 zircon populations do not show statistically significant changes of morphological type correlated to the crystal size increase. That may be interpreted as the mark of stable magmatic conditions during the zircon growth. Significant shape variations coupled to size increase were observed only for the zircons of the L3 K–bentonite. Smaller crystals (50–63 μm) belong to the D-type, with one prism (100) and one pyramid (101), while bigger crystals (80–100 μm) tend toward the J2-type: the (211)–pyramid growingly prevails over the previous face families. No (110)–prism was found, suggesting constantly elevated crystallisation temperature at $\sim$ 900 ˚C during zircon growth. Admitting that smaller crystals represent an earlier stage of zircon growth and that greater crystals are mature individuals, the enlargement of the (211)–pyramid has to be explained. The Al/alkaline ratio of the host magma might have increased during the zircon growth, following Pupin (1980), while Vavra (1990, Contrib. Min. Petr.) would favour a geometrical effect of crystal growth: a faster growth normal to zircon faces (100) and (101) would make them "grow out", up to their disappearance.

Such zircon shape and size studies require cheap procedures, and they are potentially useful tools prior to expensive U–Pb dating. In the case of K-bentonites of aeolian origin, the volcanic provenance of the presumed ash fall is better assessed, and potential mixings between several sources might be detected. More generally in modern U-Pb on zircon geochronology, the addiction to Concordia has disabled the small zircon crystals, under 60 μm in size: a tiny zircon is difficult to handle and presents greater Pb-losses. Nevertheless its shape represents an information, that is easily obtainable under SEM examination (even for 5 μm zircons), and that is invaluable for assessing the homogeneity and the growth history of the zircon population.