Geophysical Research Abstracts, Vol. 7, 08471, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08471

Epigenetic to Low-grade Tourmaline in Belgian Metaconglomerates: a Sensitive Probe of its Chemical Environment of Formation

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Although tourmaline is generally considered a valuable petrogenetic indicator, little quantitative information on the composition of diagenetic or epigenetic overgrowths is yet available (Henry & Dutrow, 1996). Besides tourmaline overgrowths from Ordovician arenites of the Tuscarora Formation, central Virginia (O'Connor, 1990) and Silurian red-bed sandstones of the Rose-Hill Formation, western Virginia (Henry *et. al.* 1994), no other compositional data of which we are aware of have been reported in literature. In both cases the tourmaline is Ca-poor, the X-site is highly deficient and the total Al-content is high, reflecting the composition of the original sediment. Furthermore, the reported tourmaline compositions also reflect host-rock control in the amount of Fe they incorporate, with tourmaline from the overgrowths in the hematite-bearing red-beds from western Virginia being slightly enriched in Fe ($Mg/(Mg+Fe_{total})$ = 0.34), compared to tourmaline in the arenites of central Virginia ($Mg/(Mg+Fe_{total})$ = 0.39 to 0.42).

The presented study reports the first observation of tourmaline overgrowths in the post-Caledonian basal conglomerates of the Belgian part of the Rhenohercynian basin, more particularly along the southeastern border of the Stavelot Massif. Of particular interest is that the overgrowths did not only develop on detrital tourmaline cores, but also along the edges of tourmalinite pebbles. Detailed optical microscope observations and microprobe data of tourmaline and chlorite were acquired in an attempt to place the post-depositional tourmaline development in the tectonic evolution of the area and to unravel any possible relation with the tourmalinite pebbles and detrital tourmaline grains present in the same conglomerates. The authigenic tourmaline occurs both as monopolar hemimorphic and bipolar asymmetrical foitite overgrowths. Electron-microprobe analyses reveal extra-ordinary high amounts of vacancies in the X-site, ranging from 64 to 83 % with a mean of 73 %, placing this amongst the most alkali-deficient foitite recorded to date. Other characteristics of the Gdoumont overgrowths are high Al, low Na and Ca contents and moderate-to-high Fe/(Fe+Mg) ratios, all reflecting the composition of the host Gdoumont conglomerates, whereas the host tourmaline grains have distinctly different compositions. The low amount of Na and Fe/Mg relations appear to rule out hydrothermal fluids as possible suppliers of boron. Furthermore the absence of discontinuous zoning suggests growth of the authigenic tourmaline in just one stage. Therefore it is most likely that tourmaline was introduced after release of boron as a result of metamorphic breakdown of detrital minerals, $e.g.$ K-feldspar and/or clay minerals. Based upon this crystal chemistry, and the observed optical properties overgrowth development must have occurred when epigenetic to low-grade conditions were reached. This is consistent with palaeotemperature determinations of previous studies as well as with chlorite compositions determined in this study. The latter occur in the examined metasediments and yield formation temperatures of just over 400˚C, reflecting peak-temperatures during greenschist grade burial metamorphism.