

Sector zoning of trace elements and oxygen isotopes in natural quartz crystals

A-L. JOURDAN¹, T.W. VENNEMANN¹, J. MULLIS², AND K. RAMSEYER³

¹Institute of Mineralogy and Geochemistry, University of Lausanne, CH-1015 Lausanne, Switzerland; Anne-Lise.Jourdan@unil.ch; Torsten.Vennemann@unil.ch

²MPI, University of Basel, CH-4056 Basel, Switzerland; Josef.Mullis@unibas.ch

³Institut für Geologie, University of Bern, CH-3012 Bern, Switzerland; Karl.Ramseyer@geo.unibe.ch

The possibility of isotopic sector zoning in natural crystals is still debated. Some studies have shown, however, that significant variations in $\delta^{18}\text{O}$ values within a common growth zone may exist for different sectors in calcite [1] and quartz [2,3]. The reason for such differences is unclear though and may be related to differences in growth mechanisms as a result of variable trace element incorporation. This possibility was explored through a combined trace element and oxygen isotope study on natural Alpine fissure and vein quartz for which the conditions of formation are different but have been well characterized.

Zoned crystals, viewed in cathodoluminescence, were first analysed for trace element content using both electron and ion microprobes. Of a range of elements analysed, only Al and Li showed significant variations, suggestive of a coupled substitution for Si. In some crystals the external zones may have an Al content of up to 2000 ppm. These same zones also have distinctly lower $\delta^{18}\text{O}$ values compared to other growth zones measured on separated chips of quartz using CO_2 -laser based methods. In addition, the different faces in this Al-rich growth zones have different $\delta^{18}\text{O}$ values. This would support disequilibrium partitioning for oxygen isotopes during growth. In contrast, ion microprobe measurements indicate no variation in $\delta^{18}\text{O}$ values for sections with Al concentrations of several hundreds of ppm for other parts of the crystal. For crystals with no detectable cathodoluminescent zoning continuous growth is suggested. For these crystals, no significant variations in trace element nor oxygen isotope compositions are observed between different faces of the same growth zone. Further studies of the oxygen isotope compositions and FTIR measurements of H^+ and OH^- are in progress.

References

- [1] Dickson J.A.D. (1991) *Nature* **353**, 842-844.
- [2] Onasch C.M., Vennemann T.W. (1995) *Geology* **23**, 1103-1106.
- [3] Klemm A., Banerjee A., Hoernes S. (1990) *Z. Naturforsch.* **45a**, 1374-1376.