Tourmaline in evaporites and meta-evaporites: Perspectives from Namibian metasediments

DARRELL J. HENRY[1], HAITING SUN[1], BARBARA L. DUTROW[1] AND JOHN F. SLACK[2]

[1]Dept. of Geology and Geophysics, Louisiana State Univ., Baton Rouge, LA 70803, USA (dhenry@geol.lsu.edu)
[2]U.S. Geological Survey, National Center, MS 954, Reston, VA 20192

Tourmalines associated with evaporitic or meta-evaporitic rocks commonly exhibit a compositional trend where there is low Al in the structural formula that is compensated by the introduction of Fe i.e., Al = Fe^{3+} exchange. This compositional trend has been found in the few occurrences of known evaporitic tourmalines: the caprock of a salt dome in the Gulf of Mexico, a brecciated and metamorphosed cap rock from Alto Chapare (Bolivia), an amphibolite-facies metaborate deposit from eastern Liaoning (China), and some tourmaline in tourmalinites from the meta-evaporitic sequence of the Duruchaus Formation (Damara Belt, Namibia – this study). These tourmalines follow a trend that defines a complete solid solution between
dravite ($NaMg_3Al_6(Si_6O_{18})(BO_3)_3(OH)_3(OH)$) or
“oxy-dravite” ($Na(MgAl_2)(MgAl_5)(Si_6O_{18})(BO_3)_3(OH)_3O$) and povondraite ($NaFe^{3+}{}_3(Fe^{3+}{}_4Mg_2)(Si_6O_{18})(BO_3)_3(OH)_3O$). These trends are interpreted to represent tourmalines developed in an Al-poor, Fe^{3+}-rich environment, consistent with evaporitic settings.

Although some of the tourmalines from the Duruchaus Formation follow this Al for Fe^{3+} trend, a number of clearly meta-evaporitic tourmalines do not. The tourmalinites in two of the three localities studied are interlayered with biotite- and muscovite- semipelite and with calcite-dolomite marble. Despite their derivation from evaporitic sediments (tourmalinites preserve pseudomorphs after a variety of primary evaporitic minerals), the tourmalines in these tourmalinities exhibit an Al- and Mg-rich composition that appears to reflect a local compositional influence from the semipelitic interlayers. In fact, these Al-Mg-rich compositions are similar to those found by Prof. Werner Schreyer and his colleagues in tourmalines from the ultrahigh-pressure rocks of the Dora Maira massif (Italy) that they interpreted as meta-evaporites.

Geochemistry of cold vent fluids at the Central American Convergent Margin

C. HENSEN[1], K. WALLMANN[1], M. SCHMIDT[2], V. LIEBETRAU[1], U. FEHN[3], D. GARBE-SCHÖNBERG[2] AND W. BRÜCKMANN[1]

[1]IFM-Geomar, Kiel, Germany (chensen@ifm-geomar.de; kwallmann@ifm-geomar.de; vliebetrau@ifm-geomar.de; wbrueckmann@ifm-geomar.de)
[2]Geosciences, CAU, Kiel, Germany (mas@gpi.uni-kiel.de; dgs@gpi.uni-kiel.de)
[3]Univ. of Rochester, NY, USA (fehn@earth.rochester.edu)

The active continental margin offshore Central America is characterised by a high number of cold vent sites associated with typical sea floor features such as mud volcanoes and diapirs (mounds) or submarine slides. Over the past couple of years a solid geochemical data base of fluid samples has been collected from various locations along the Costa Rica - Nicaragua forearc. Similar to pore fluids from other, mostly accretionary convergent margins, these fluids are typically less saline than normal seawater. There is clear evidence (using oxygen and hydrogen isotope ratios) that chloride-depleted fluids originate from clay-mineral dehydration processes at elevated temperature and pressure conditions. This interpretation is supported by a number of additional observations such as the occurrence of thermal methane and highly elevated boron concentrations. Due to the lack of suitable conditions for the presumed processes within the sedimentary sequence of the overriding plate, it has been hypothesized that the fluids may originate from mineral dehydration in subducted sediments at about 10 km depth (Hensen *et al*. 2004). This is supported by mass balance estimates between input of mineral-bound water by subducting sediments and output through known vent sites. At many sites, however, the geochemical signature does not reveal clear evidence for a “deep” origin, such as the abundant occurrence of shallow biogenic gas. Conspicuous differences in the geochemical composition of fluids from various locations allow a general subdivision into regional, potentially structurally-controlled, types. We will present a comprehensive description of the available data set – covering the main element composition and various isotope systems ($\delta^{18}O$, δD, $\delta^{13}C$, $^{87}Sr/^{86}Sr$, $\delta^{44}Ca$, $^{129}I/I$) – and discuss fluid sources and potential ages as well as processes of formation and alteration. In addition, we will present an outline of current efforts to drill key sites of the most prominent dewatering structures within IODP (633 full2, Costa Rica Mounds).

Reference

Hensen C., Wallmann K., Schmidt M., Ranero C. R., and Suess E., (2004), *Geology* **32**, 201-204.