

Tourmalines from the Morro da Pedra Preta Formation, Serra do Itaberaba Group - SP (Brazil)

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Pre- and syn-metamorphic sea-floor hydrothermal activity caused sulfidation, silicification, carbonatization and conspicuous tourmalinization of the Mesoproterozoic Morro da Pedra Preta Formation (MPPF), gold-bearing volcanic-sedimentary sequence of the Serra do Itaberaba Group (São Paulo, Brazil).

Tourmalinites and metacherts interpreted as BIF facies contain tourmalines of intermediate schorl-dravite compositions (labeled fields in Fig. 1), whereas tourmalines of correlated metasediments are richer in Mg and Al (open and filled triangles in fields 4 and 5 of Fig. 1).

Andesite/dacite bodies emplaced during the backarc regime that affected MPPF provided heat for the circulation of fluids with sedimentary signature attested by stable isotope analyses. Leaching of elements of the volcanic pile generated tourmalines whose (less-)Al and (more-)Ca contents mirror the compositions of the host rocks (amphibolites - crosses, and basic metatuffs - filled squares, in fields 5 and 6 of Fig. 1). The tourmalines of the volcanoclastic rocks (open triangles plotting in the boundaries of fields 2, 3, 5 and 6 of Fig. 1) are richer in Fe, probably reflecting some contribution of the intrusive bodies.

The circulation of the hydrothermal fluids was also responsible for the redistribution of gold in the MPPF rocks.

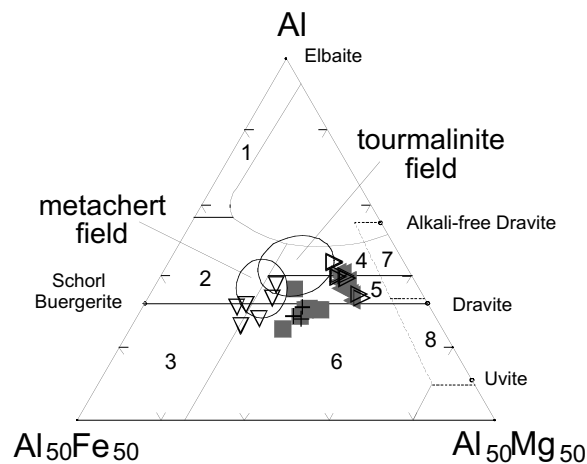


Figure 1: MPPF tourmaline compositions plotted in the Al-Fe-Mg diagram (numbered fields as in Henry & Guidotti 1985, *Am. Mineral.* **70**: 1-15).

Role of secondary minerals in retention of fission products and actinides in natural environments

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Studies of the uranium deposit of Cigar Lake and of the natural nuclear fission reactors of Gabon show that the mineralogy of the hosted rocks and the chemistry of the fluids are important parameters for the design of materials of HLW nuclear wastes. They show similar phenomena of hydrothermal alteration of the ore containing sandstones as well as of clay formation around the U ore. This clay halo provides effective redox buffering and played together with the organic matter an important role in the long-term preservation of the main ores. High amounts of Ca (potentially Ra), Sr and LREE were found to be coprecipitated by Al-phosphates in the clay halo. Clay minerals and Ti-oxide were found to have sorbed significant amounts of U. Sorption onto mineral surfaces was followed by the formation of coffinite ($USiO_4 \cdot nH_2O$). Uraninite crystals retain most of the actinides produced by the fission reactions. When uraninite becomes hydrothermally altered or transformed during supergene weathering, the reduced conditions in the close vicinity of the U ore allows its precipitation in newly formed Si-P-REE-uranium minerals (Coffinite). The formation of coffinite and U-bearing phosphate minerals is an important factor for the long-term preservation of radioactive material because it retards the mobility of actinides and fissionogenic lanthanides. The formation of these minerals seems to be mainly related to the weathering of U ores and to the interaction with meteoric fluids. The radionuclides adsorbed on the surface of the altering clay minerals become incorporated into the structure of the newly formed coffinite. Thus, in the performance of a clay barrier coffinite is among the secondary silicate minerals a very important sink for radionuclides. Despite the potential important role of coffinitization for radionuclide transport and retardation, little is known on the thermodynamic constant and the kinetics of formation of this mineral.