Tourmaline from porphyry copper belts as a proxy to assess boron budget in arc magmas

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In the Andes, world-class porphyry Cu deposits are intimately associated to major changes in the subduction geometry (progressive flattening) resulting in episodes of intense deformation, crustal thickening, rapid uplift and erosion (major orogenic phases), accompanied by migration of the volcanic front and changes in the geochemistry of magmas (appearance of the adakitic signature). As consequence of these highly compressive events, volcanism tends to vanish leaving mostly plutonic rocks in the geologic record. Whole-rock analysis of these intrusive rocks offers no quantitative appraisal of the B content in their magmas if volatile exsolution has taken place. On the other hand, during these particular periods of the Andean orogen evolution, volatiles exsolved from magmas are the main source of B-bearing hydrothermal fluids from which tourmaline may precipitate in porphyry Cu deposits. Therefore, the assessment of the relative abundance of this borosilicate in copper deposit belts could cast some light on B abundance in the associated arc magmas during metallogenic periods.

Tourmaline breccia complexes, with up to ~20 vol% of tourmaline, are a characteristic feature of world-class porphyry Cu deposits from the ~370 km long, Late Miocene-Early Pliocene Cu belt from Central Chile, as well as, of prospects and deposits from the ~1500 km long, Paleocene-Early Eocene Cu belt from Northern Chile and Southern Peru. In contrast, tourmaline is rarely developed or relatively uncommon in most porphyry Cu deposits from the ~2000 km long, Late Eocene-Early Oligocene belt from Southern Peru and Northern Chile.

Considering that the amount of fluid involved in giant porphyry Cu deposits formation requires huge volumes of magma (up to ~2000 km^3), the tourmaline-poor nature of the Late Eocene-Early Oligocene Cu belt, hosting giant Cu deposits (e.g.: Chuquicamata, La Escondida), suggests that the associated magmatism, and by extension its source, was fluid-bearing but B-poor. A possible explanation for the low B budget in these arc magmas could be related to a particular thermal configuration of the downgoing oceanic plate.

A high-resolution paleohydrological record of the Younger Dryas episode from Western Europe – Using lipid biomarker D/H ratios

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Despite the recognized importance of the hydrological cycle within the climate system it is difficult to predict hydrological consequences of current and future climatic changes on regional scales. However, regional climatic variations on the continents are often most dramatically expressed through hydrological changes. A key tool to better understand the underlying mechanisms is the reconstruction of the past climate changes from high-resolution lacustrine proxy data. We investigated how fast hydrological changes have taken place during abrupt climatic shifts, such as the Younger Dryas cold episode (YD) ca. 12 ky BP. We assessed this question with a novel proxy, the stable hydrogen isotope composition of higher-plant derived lipid biomarkers.

We analyzed sediments from Lake Meerfelder Maar (Germany), with a continuous annual varving during the YD, which provide an excellent archive to resolve this issue. We measured the hydrogen isotope ratios of higher plant lipid biomarkers (long-chain *n*-alkanes) and conducted X-Ray fluorescence analyses (XRF), with focus on catchment-typical allochthonous elements (K, Al, Ti) in high-resolution (8-33 years per sample). The average chain length of the *n*-alkanes shows short-term variabilities, suggesting changes in lake catchment ecology. While *n*-alkanes with the highest concentration are long-chain homologues (nC_{25}, nC_{27}, nC_{29}, nC_{31}) of terrestrial origin, an increase in nC_{23} produced mainly by aquatic macrophytes suggests changes in the aquatic ecology during the early YD. XRF data show pronounced changes in sedimentary conditions with more allochthonous sediments in the later YD, probably related to hydrological variations. Indeed, the results from hydrogen isotope analysis, with a significant isotopic depletion in leaf-wax *n*-alkanes of about 20 ‰ during the initial part of the YD relative to Allerød, suggest colder conditions and/or enhanced precipitation. Furthermore, our data provide additional evidence for two hydrologically distinct periods within the YD interval. Through a combination of biomarker D/H ratios with XRF data our results deliver new insights into the timing and magnitude of regional hydrological changes as a consequence of abrupt global climatic variations.