LA-ICP-MS geochronology of detrital zircons in Late Paleozoic turbidte units of northern Chile: Implications for terrane processes

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Late Devonian to Permian turbidite units are widely exposed along the coast of northern Chile and represent parts of an accretionary wedge at Gondwana's Late Paleozoic active margin in the present Central Andes. The units overstep the boundary between the somewhat enigmatic Ordovician to Devonian Chilenia terrane of alleged Laurentian origin in the south and coeval autochthonous regions of Gondwana to the north. Zircon populations of overstepping units deposited on and derived from Chilenia should ideally demonstrate the Laurentian heritage of the terrane by an absence of geochronologic events typical of Gondwana and absent from Laurentia, i.e. the Brasiliano orogenic cycle.

Using LA-ICP-MS we analysed populations of detrital zircons in 6 samples, 2 each pertaining to the El Toco and Las Tórtolas Formations in the northern, autochthonous part of the study area, and 2 samples from the Huasco and Huentelauquen Formations on Chilenia. Of each sample we analysed 140 to 145 grains. In this study we only considered grains falling within 10% of concordia. This number of grains varies between 99 and 118 between samples.

Concerning the Precambrian and Early Paleozoic, all samples show essentially the same distribution of main events, the "Grenvillian" orogenic cycle between 1400 and 900 Ma, the Brasiliano cycle between 800 and 550, and the Early Paleozoic Famatiniano active margin cycle between 550 and 420 Ma. The younger, Late Carboniferous-Permian samples also register a cluster of ages between 330 and 290 Ma marking the re-initiation of subduction magmatism at this margin after a period of magmatic, tectonic and metamorphic quiescence in the Late Silurian and Devonian.

Considering the variable Late Paleozoic ages of the studied samples we find that all record a very similar distribution and succession of geochronologic events, including evidence of the Gondwanan Brasiliano cycle in all samples. Even though margin parallel sediment transport could account for some of these grains, the size of Chilenia (>1000 km N-S) should have kept this influence small. In conclusion we find that our data cast doubt on a Laurentian origin of the Chilenia terrane in northern and central Chile.

The effect of organic compounds on the dissolution of amorphous silica-Pyrochatechol, Salicylate, Hydrogen Phthalate

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Silicon (Si) is one of the most common elements constructing the earth's crust and much of it is present in different kinds of silica minerals (SiO_2). Information on the mobility and transport of Si from minerals to water as silicic acid ($Si(OH)_4$) is important to estimate the chemical weathering of rocks. The dissolution of silica has been investigated vigorously in inorganic salt solution included in natural waters. On the other hand, a lot of organic compounds (from simple organic compounds with low molecular weight to polymer with high molecular weight) are also present in natural waters. Only a few investigations have been conducted on the effect of organic compounds on the dissolution of silica and the interaction between silica and organic compounds is still uncertain. In an oil field, the groundwater with higher Si concentration than the solubility of quartz was found and the Si concentration increased with increasing the total organic carbon in the ground water, suggesting that organic compounds may accelerate the dissolution of quartz. A phenolic hydroxyl group and a carboxyl group are often contained in main functional groups in natural organic compounds such as humic acid.

In order to search functional groups that can strongly interact with silica, in this study, we investigated the effect of pyrochatechol with two hydroxyl groups, salicylate ion with one hydroxyl group and one carboxyl group and phthalate ion with two carboxyl groups on the dissolution of amorphous silica. In conclusion, salicylate and phthalate ions inhibited the dissolution of silica due to adsorption on the surface of silica through hydrogen bonds, whereas pyrochatechol accelerated the dissolution due to formation of silicic acid-pyrochatechol complexes.

References

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