# Sedimentary sources revealed by Nd isotopes: the Late Palaeozoic of southern Andean Patagonia

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Whole rock samples of Late Devonian to Early Carboniferous metaturbiditic greywackes have been analysed for its Nd isotopes to define possible sources for the sediments. The result is interpreted together with the petrography and the geochemistry of the rocks. The studied sediments are part of the so called basement of the Andes; the oldest rocks in southernmost Andean Patagonia. They are deformed and low-grade metamorphosed, due to their position in the back-stop of a Late Palaeozoic to Early Mesozoic accretionary wedge.

The petrographic framework is dominated by quartz grains. Polycrystalline lithic fragments are sparce. The cathodoluminenscence characters of individual quartz grains reveal a dominance of quartz of metamorphic and plutonic origin. Volcanic quartz grains are rare. Further, signs of recycling can be seen. The geochemistry indicates that the sediments mainly had felsic source rocks. However, based on petrographic and geochemical data alone, the discrimination of the tectonic setting (passive vs. active tectonic margin) for the main sources of the metaturbidites was not satisfactory.

A first set of samples from the mainland of southern Chile have been analysed for its Nd isotopes. They show Grenvillian Nd model ages with a main interval of 1340-1490 Ma. Thus, the source rocks were part of a Precambrian crust in the Late Palaeozoic. For the model age calculation a multistage model was used, which allows for disturbance of the isotope signal at the time for deposition. The mean interval for $\_{Nd}$(T=sed) is between -6 and –4.5; further indications of a felsic, crustal origin for the sources. Further analyses will show if similar rocks from the Chilean archipelago and western Argentina have corresponding Nd signatures.

The analysed Chilean Late Devonian to Early Carboniferous metasediments have similar Nd model ages to pre-Devonian metamorphic, cratonic rocks situated in Extra-Andean Argentinian Patagonia. The sources of the Chilean turbidite deposits are suggested to be of the same origin as the Extra-Andean rocks. Thus, we suggest that the main sedimentary input came from the interior of Gondwana.

# Sulfides from the lower mantle?

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The Lac de Gras (Slave Craton, Canada) kimberlites sampled monosulfide solid solution (mss), Ni-Co-rich sulfides ($(Ni,Fe)_{3-x}S_2$) and Fe metal included in peridotitic minerals. This inclusion suite is unusual because: (1) $(Ni,Fe)_{3-x}S_2$ have low Ni/Co (mean 6.5 versus 21 for chondrite); (2) all $(Ni,Fe)_{3-x}S_2$, a subgroup of the mss and the Fe metal inclusion have high mean W-contents of 1.2, 1.6 and 2.9 wt%, respectively, and high W/Mo; (3) $(Ni,Fe)_{3-x}S_2$ has lower Fe/Ni (0.2), Fe/Co (1.3) and higher metal/sulfur (1.2) than any sulfide suite world-wide.

We suggest the following three steps for the formation of both sulfides and metal: (1) low Ni/Co was acquired by equilibration of a metal-rich sulfide melt with silicate melt at mid-mantle pressure where $D_{Co}^{metal\ melt/silicate\ melt}$ becomes > $D_{Ni}^{metal\ melt/silicate\ melt}$ (Li and Agee, 2001); (2) high $D_W^{metal\ melt/Mg\text{-}wüstite}$ relative to $D_{Mo}^{metal\ melt/Mg\text{-}wüstite}$ and $D_W^{metal\ melt/silicate\ melt}$ (Ohtani et al., 1997) suggests high W contents and W/Mo were acquired by percolation of the metal-rich sulfide melt through the lower mantle; (3) cooling led to exsolution of this melt into S-rich and S-poor melts, with partitioning of Ni and Co into the S-rich melt, and depletion in the S-poor melt (Ballhaus and Ellis, 1996). The S-rich melt precipitated nickeliferous mss. The residual liquid became progressively depleted in S, and enriched in Ni and Co, until melt of the composition $(Ni,Fe)_{3-x}S_2$ was trapped. The S-poor melt precipitated Fe metal with low Ni and Co contents. This scenario is supported by strong negative Ni and Co anomalies in the Fe metal relative to elements of similar siderophile nature.

Modelling the three-step formation using distribution coefficients approximates the compositions of our samples although there are uncertainties in the formation conditions and applicability of the partitioning data. Sulfides and Fe metal from Lac de Gras may have been trapped in the lower mantle during the Earth's accretion, when dense metal-rich sulfide melts percolated the lower mantle *en route* to the core after equilibrating at the base of a deep magma ocean.

## References

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