6.2.36

The influence of slab melting processes on the global Nb-Ta budget

C. MÜNKER[1], A. POLAT[2] AND G. YOGODZINSKI[3]

[1] ZLG, Institut für Mineralogie, Universität Münster, Münster, Germany (muenker@nwz.uni-muenster.de)
[2] Dept. of Earth Sciences, University of Windsor, Windsor, Canada (polat@uwindsor.ca)
[3] Dept. of Geological Sciences, University of South Carolina, Columbia, USA (gyogodzin@mail.geol.sc.edu)

All accessible reservoirs of the silicate Earth display lower Nb/Ta ratios than chondrites (~ 20 [1]). In these resevoirs, Nb is depleted on average relative to its geochemical twin, Ta, by ~ 30%. Two models have been proposed to explain this feature, commonly referred to as the “terrestrial Nb/Ta paradox”. In one model, the missing Nb is stored in the Earth´s core, following experimental evidence that Nb becomes siderophile at higher pressures [2]. Alternatively, Nb may be stored in old, subducted, refractory eclogite residing in the Earth´s lower mantle [3] implying that Nb and Ta are fractionated at a globally significant scale by subduction processes. In the light of recently published data [1], there is strong evidence that significant amounts of Nb are hosted by the Earth’s core. This is because: i) no major terrestrial silicate reservoir (including OIB) has superchondritic Nb/Ta [1,3] and ii) Nb/Ta ratios in Archean mafic magmas are similar to those in Cenozoic basalts [1]. To examine the significance of subduction processes for the global Nb-Ta mass balance, we evaluated the behaviour of Nb and Ta during slab melting processes which were particularly important during crust formation in the Archean. As representative suites, we examined 2.7 Ga old adakites from the Superior Province, Canada and for comparison, young adakites from the Aleutian arc for their Nb/Ta and Zr/Hf compositions using isotope dilution and MC-ICPMS [1]. Zr/Hf ratios in the adakites range from 35-39 and Nb/Ta ratios from 12-17, indistinguishble from ratios displayed by coeval calc-alkaline basalts and present day MORB. Most important, Nb/Ta is negatively correlated with Zr/Sm and Nb/La but not correlated with Zr/Hf. This suggests that: i) Nb/Ta and Zr/Hf are only weakly fractionated during melting of subducted oceanic crust and ii) each element pair is controlled by a different process during slab melting. The observed co-variation of Nb/Ta with Zr/Sm and Nb/La is best explained by rutile and amphibole in the residuum [4]. Altogether, there is little evidence from the Superior Province and Aleutian data that Nb/Ta was significantly fractionated by subduction processes over geologic time.

References

[1] Münker C. et al. (2003) *Science* **301,** 84-87.
[2] Wade J., Wood, B.J. (2001) *Nature* **409,** 75-78.
[3] Rudnick, R.L. et al. (2000) *Science* **287,** 278-281.
[4] Foley S.et al. (2002) *Nature* **417,** 837-840.

6.2.P01

Archean protominerals and their evolution during chert formation: Kittys Gap, Pilbara Complex

V. ROUCHON[1], B. ORBERGER[1], F. WESTALL[2], J-P GALLIEN[3] AND D.L. PINTI[1]

[1] Dept. des Sciences de la Terre, FRE Orsayterre 2566, Université Paris XI, 91405 Orsay Cedex (rouchon@geol.u-psud.fr)
[2] Centre de Biophysique Moléculaire, CNRS, Rue Charles Sadron, Orléans cedex 2 45071, France
[3] Laboratoire Pierre Süe, CEA-CNRS, UMR 9956, CEA Saclay, F-91191, Gif-Sur-Yvette Cedex, France

Archean cherts from Kittys Gap, Coppin Gap belt, Eastern Pilbara block were previously described as silicified lagoonal deposits [1]. To precisely characterise the primary deposits, a structural, mineralogical and mineral-chemistry study was carried out on a sample previously studied for bacteriomorphous structures [2].

The chert has an inframillimetric to millimetric black and white lithification. The black and white laminae differ in their hydromuscovite (HM) and ghost crystals (GC) contents, the white layers being richer (50-80% v.). Organic matter occurs as clusters or as microbial mats and predates silicification. Three types of GCs have been distinguished by SEM and EDX: 1. 50-100 µm euhedral to subhedral crystals shapes replaced by HM are underlined by nanometric Ti-oxide spherules. 2. 100-300 µm euhedral crystals replaced by HM. 3. Quartz (Qz) phenocrysts. Possible protolithic minerals for the mentioned GCs include: 1. Ti-bearing mica; 2. K-feldspar; 3. Qz. Accessory monazite and zircon associated with pseudoamorphous mixtures of Zr-Ti-REE and U are more abundant in the white laminae. The mineralogical association suggests an acidic volcanic protolith, with deposits varying in granulometry from very fine ash to porphyric clasts (black and white laminations). During alteration and silicification, K-Al minerals were replaced by HM and cryptocrystalline Qz. Zoned and corraded zircons are magmatic in origin. Monazites and Ti-oxides textures indicate a secondary origin with source REE, P and Ti liberated *in situ* during hydrolysis of primary magmatic minerals (and glass).

Nuclear microprobe analysis indicated the occurrence of 100-450 ppm N and 1000-6000 ppm C in K-Al-sheet silicates suggesting that N substitutes K+ in the form of ammonium (NH4+).

References

[1] Nijman, W., Willingers, B.J.A., Krikke, A. (1999): *Prec Res.* **95**, 277-302.
[2] F. Westall, (2003). *Geophys. res. Abst*, **5**: EAE03-A-04958. 3.45 Gy.-old microbial associations in cherts from Pilbara : lessons for potential martian life.