Igneous sulfides in gabbros of the lower oceanic crust: IODP Hole U1473A, Atlantis Bank, Southwest Indian Ridge

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IODP Expedition 360 drilled the 810-m-deep U1473A hole into the lower crust of the Atlantis Bank ocean core complex at the Southwest Indian Ridge [1]. We found a long section of sulfide-rich gabbro at a depth of 615 to 730 mbsf. Sulfides with grain sizes up to 8 mm are characteristic for the gabbro from this depth interval. To the best of our knowledge, sulfide grains of this size are unusual in the lower oceanic crust *in situ*. The occurrence of these sulfides is thus intriguing and raises question about their origin.

The sulfides occur as polysulfide grains composed of pyrrhotite (~80 vol.%), chalcopyrite (~15 vol.%), and pentlandite (~5 vol.%). The pentlandite contain up to 15 wt.% Co. The high Co content along with variable Fe/Ni ratio of the pentlandite indicates an equilibrium temperature of >400 °C [2]. This suggests the pentlandite exsolved from a monosulfide solid solution, and consequently that the sulfides are igneous. This interpretation is supported by the presence of troilite and pentlandite exsolutions throughout the pyrrhotite, and globular inclusions of sulfide grains in clinopyroxene. Similar assemblages of igneous sulfides are found in magmatic sulfide deposits, for example in the Bushveld complex [3].

The mineral composition of the sulfide grains is consistent throughout the hole. The excessive sulfide modes in the key interval are however perplexing when compared to the moderate sulfide modes upper in the hole. One possible explanation could be an addition of sulfur to the sulfide-forming melt by interactions with the country rocks abutting the key interval. To better constrain the source of inherent sulfur we have begun a study of sulfur isotopes. This data will also be presented at the conference.

[1] MacLeod *et al.* (2017) IODP Proc, **360**. [2] Kaneda *et al.* (1986) Miner Deposita **21**, 169–180. [3] Kanitpanyacharoen & Boudreau (2013) Miner Deposita **48**, 193–210.