**PhD project**

**Uplift history, intrusive sequence, and skarn mineralisation at the giant Antamina deposit, Peru**

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**Introduction and background**

Antamina is one of the world’s giant ore deposits and the largest known skarn deposit. The current resources are 1934 Mt of ore averaging 0.84% Cu, 0.54% Zn, 9.8 g/t Ag and 0.019% Mo (proven and probable ore reserves plus measured, indicated and inferred resources; based on Antamina announcement on March 16, 2011; [http://www.antamina.com/en/content.php?825/news_and_publications/compa_ia_minera_a ntamina_s_a_announces_updated_mineral_resource_and_ore_reserve_estimates.html](http://www.antamina.com/en/content.php?825/news_and_publications/compa_ia_minera_antamina_s_a_announces_updated_mineral_resource_and_ore_reserve_estimates.html)). The mineralisation is still open at depth. The mine design indicated that it would be the world’s 3rd largest producer of concentrates, with 3rd largest annual production of Zn and 7th largest annual production of Cu (Redwood, 1999).

There are abundant endoskarns and exoskarns at Antamina. The skarns occur above, surrounding and in an intrusion complex mainly composed of porphyritic, monzogranitic rocks (Love et al., 2004). Numerous intrusions have been noticed during logging, indicated by sharp contact boundaries and chilled margins, but the exact phases and intrusive sequence are yet to be documented. Recent deep drilling has shown that the skarns extend for at least 2 km to the depth, and grade/mineralisation is generally stable over the ~2 km vertical internal. In most of the drilled, upper part of the intrusion complex, there are minor porphyry-style quartz veins but with almost no mineralisation (Larry Meinert and Steve Windle, 2012, personal communication). Recent deep drill holes exposed more breccias with chalcopyrite mineralisation in the intrusive complex at the end of the holes, which was suspected to indicate a transition to porphyry-style mineralisation (Steve Windle, 2012, personal communication).

**Aims and key questions to address**

Why the Antamina skarn is so big? There must have some unusually favourable conditions working together to make this giant deposit. This study will try to decode the secret ingredient of the abundant mineralisation. In particular, the project will address:

1) What made the vertical extension of skarn mineralisation so long, up to 2 km?
2) What are the intrusive phases and what is the intrusive sequence? Which phase(s) caused skarn formation and mineralisation?
3) The uplift and erosion history during the formation of the skarns, and its relationship with skarn mineralisation
4) The transition from skarn to potential porphyry mineralisation
5) The reason of the unusual proximal Zn mineralisation. Typically Zn is distal and Cu is proximal. But at Antamina Zn mineralisation occurs together with Cu mineralisation. Chang and Meinert (2004, 2008) proposed that similar proximal Zn mineralisation at Empire skarn, Idaho, was perhaps related to high F activities. Is F also the reason at Antamina? Could F also have contributed to the abundance of mineralisation?

The project will improve the understanding of the formation processes, and thereby help exploration to further depth, in the peripheral areas around Antamina, and elsewhere in the world.

References


