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Research paper

Structure of the Panzhihua intrusion and its Fe-Ti-V deposit, China

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ABSTRACT

The Panzhihua intrusion in southwest China is part of the Emeishan large igneous province and host of a large Fe-Ti-V ore deposit. In previous interpretations it was considered to be a layered, differentiated sill with the ore deposits at its base. New structural and petrological data suggest instead that the intrusion has an open S-shape, with two near-concordant segments joined by a discordant dyke-like segment. During emplacement of the main intrusion, multiple generations of mafic dykes invaded carbonate wall rocks, producing a large contact aureole. In the central segment, magmatic layering is oriented oblique to the walls of the intrusion. This layering cannot have formed by crystal settling or in-situ growth on the floor of the intrusion; instead we propose that it resulted from inward solidification of multiple, individually operating, convection cells. Ore formation was triggered by interaction of magma with carbonate wall rocks.

1. Introduction and geological setting

The Emeishan large igneous province, emplaced 260 Ma ago in SW China, contains several large mafic-ultramafic ore bearing intrusions (Zhang et al., 2009; Shellnutt et al., 2011), such as Hongge intrusion (Zhong et al., 2002, 2003), Xinjie intrusion (Zhong et al., 2004, 2011), Baima (Wang and Zhou, 2006) or Panzhihua. In this paper we discuss the structure of the large Fe-Ti-V-bearing Panzhihua intrusion, and its implications for the formation of the ore deposit. The geological setting of the intrusion and its ore deposits has been discussed in many other papers (Zhou et al., 2002, 2005, 2008; Ganino et al., 2008; Pang et al., 2008) and will only be briefly outlined here.

The intrusion had previously been interpreted as a sill-like body that dips 50–60°NW and extends NE–SW for about 19 km (Fig. 1). It is layered throughout (Fig. 2), being characterized by decimetre- to centimetre-scale layers of contrasting mineralogy and grain size. Zhou et al. (2005) and Pang et al. (2008) reported that the intrusion is differentiated from highly mafic, often magnetite-rich, melanogabbro at the base, grading through normal gabbro to leucogabbro near the top. It intrudes late Proterozoic dolostones, marls and quartzites, which, at the contact of the intrusion, have been transformed into marbles and skarns within an up to 300-m-thick contact aureole. The upper aureole is not observed because the NW margin of the intrusion is cut by a fault and intruded by syenite.

The intrusion hosts several large magmatic Fe-Ti-V oxide ore deposits. These occur as magnetite-rich cumulate layers or discordant lenses that are distributed along the southeast margin of the intrusion, in some cases extending down into the wall rock marble (Zhou et al., 2005).

2. Methods

During field trips in February–March 2010 and November 2011, we remapped the northern part of the intrusion and part of its contact aureole, and conducted a systematic structural investigation, focussing mainly on the intrusion itself. The large open-pit mines of Lanjian and Zujiabaobao provide excellent exposure (Fig. 2a) which is largely absent in the surrounding countryside. We paid particular attention to the contact between the gabbro and

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