

Roberto Oyarzun · Jorge Oyarzún · Jean Jacques
Ménard · Javier Lillo

The Cretaceous iron belt of northern Chile: role of oceanic plates, a superplume event, and a major shear zone

Received: 18 November 2002 / Accepted: 3 March 2003 / Published online: 17 May 2003
© Springer-Verlag 2003

Abstract The Cretaceous constitutes a turning point in the tectonic, magmatic, and metallogenic history of Chile. The geological evidence indicates that a major change occurred in late Neocomian time when superplume emplacement (Mid-Pacific Superplume) and plate reorganization processes took place in the Pacific. The superplume event resulted in a major ridge-push force resulting in increased coupling between the subducting and overriding plates. This completely changed the tectonic setting of Chile ending the Early Cretaceous extensional period (aborted rifting in the back-arc basin), and increasing stress at a crustal scale. As a consequence, overpressurized dioritic magmas were pushed up mainly along the best possible structural path in northern Chile, i.e., the Atacama Fault Zone, eventually forming a +500-km-long belt of Kiruna-type iron deposits with reserves of ~2,000 Mt (60% Fe), a unique case in Chile's geological history.

Keywords Iron belt · Cretaceous · Chile · Shear zone · Superplume

Editorial handling: Robert King

R. Oyarzun (✉)
Departamento de Cristalografía y Mineralogía,
Facultad de Ciencias Geológicas,
Universidad Complutense, 28040 Madrid, Spain
E-mail: oyarzun@geo.ucm.es

J. Oyarzún
Departamento de Ingeniería de Minas and CEAZA,
Facultad de Ingeniería, Universidad de La Serena,
Casilla 554 La Serena, Chile

J. J. Ménard
Institut Pédagogique National,
BP 616, Nouakchott, Mauritanie

J. Lillo
Escuela Superior de Ciencias Experimentales y Tecnología,
Universidad Rey Juan Carlos,
Tulipán s/n, 28933 Móstoles Madrid, Spain

Introduction

Although Chile is usually regarded as a “copper country” (largely due to the presence of giant porphyry copper deposits), other ores including iron are also present in important economic concentrations. Most of the Chilean iron deposits are of the Kiruna type, and occur along a narrow N–S trending belt stretching for over 500 km between 25° and 30°S (Fig. 1). These deposits formed by the end of the Late Cretaceous, and from a structural point of view, can be regarded as shear zone related. The deposits have been largely studied petrologically, geochemically, and economically; however, no specific attempts have been made in order to relate the origin of the Chilean Iron Belt (CIB) to the Pacific plate tectonic scenario. In this paper, we present a brief account of the northern Chilean case, a realm that underwent profound changes in tectonic, magmatic, and metallogenic style during Cretaceous time (Oyarzún 2000). We suggest that this change happened in response to major, distal tectonic events taking place in the Pacific, involving the emplacement of a plate-wide superplume (Mid-Pacific Superplume; Larson 1991a, 1991b; Vaughan 1995). In the following, we present a summarized geologic account of these processes and their probable influence on the development of the unique iron metallogenic belt in northern Chile.

The tectonomagmatic scenario

The Jurassic-Early Cretaceous plate tectonic setting of Chile was intimately linked to the southeastward directed subduction of the ancient Aluk plate (Fig. 2A). The geological evolution of northern Chile during this time span was characterized by a tectonic setting involving a magmatic-arc and a back-arc basin. This setting underwent minor readjustments by the Late Jurassic (Oxfordian), when the marine basin was uplifted giving rise to evaporitic facies. By the Tithonian, the basin had deepened again and the system arc basin had undergone