

AYNAK: A WORLD-CLASS SEDIMENT-HOSTED COPPER DEPOSIT, AFGHANISTAN

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ABSTRACT: The Aynak copper deposit, 30 km south of Kabul in Afghanistan, was discovered by Afghan-Soviet geologists in the 1970s. Extensive exploration from 1974-89 included drilling, trenching and adits. This delineated several large ore bodies and smaller lenses with a reported resource figure of 240 Mt at 2.3% Cu (ESCAP, 1995). Mineralisation is stratabound and consists of disseminated bornite and chalcopyrite in a cyclic sequence of metamorphosed sediments of late Precambrian age. A model proposes copper was leached from underlying volcanic rocks by circulating brines and then moved up faults to deposit copper sulphides within the overlying sediments.

KEYWORDS: Sediment-hosted copper deposit, Afghanistan

1 INTRODUCTION

The largest and best-known copper deposit in Afghanistan is the world-class Aynak sediment-hosted stratiform copper (SHSC) deposit, approximately 30 km south of Kabul (Figure 1). Aynak occurs within the Kabul Block, a north-north-east-trending lenticular shaped block, approximately 200 km long and 50 km wide. This block, which also contains several other copper deposits including Darband and Jawkhar, is one of a series of microplates that broke off from Gondwana around 250 Ma and accreted onto the margins of Laurasia.

2 PREVIOUS EXPLORATION

Soviet and Afghan geologists undertook extensive exploration in the Aynak area during two phases, from 1974 to 1976 and again from 1978 to 1989. This work included several hundred boreholes, seventy trenches and nine exploratory adits as well as ground-based geophysical surveying and mapping. During this work, the Afghan-Soviet geologists identified four principal and 28 smaller lens-like mineralised zones at Central Aynak, and 20 zones in Western Ay-

nak. The major mineralised zones at Central Aynak were traced for 1850 m along strike and 1200 m down dip with a maximum thickness of 210 m. At the Western Prospect, mineralization was traced for 2230 m along strike, 1640 m down dip with a maximum thickness of 214 m. An Afghan-Soviet reported resource figure of 240 Mt at 2.3% Cu was calculated for both deposits, assuming a cut-off grade of 0.4% Cu (ESCAP, 1995).

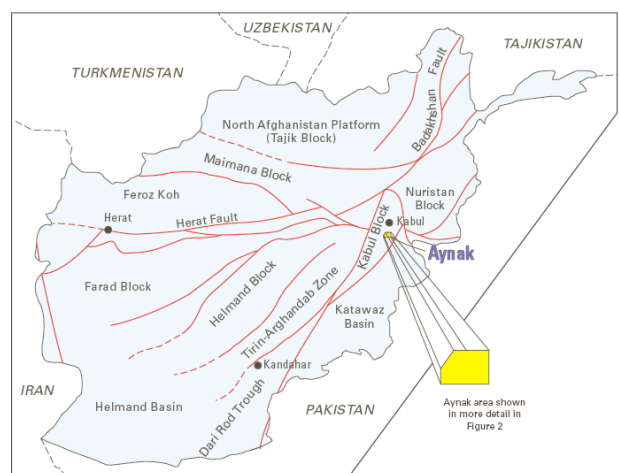


Figure 1. Structural map of Afghanistan and location of the Aynak copper deposit. Aynak area shown in more detail in Figure 2.

3 STRUCTURE

The structure at Aynak is dominated by the Aynak anticline. The anticline is asymmetrical and approximately 4 km in length and up to 2.5 km wide. The south-eastern limb dips gently to the south-east but the north-western limb is steeply dipping and in places overturned, with dips of 45-70° to the south-east. The periclinal closure of the anticline at its western end is asymmetrical. Here, the southern limb is overturned and the axial plane is inclined towards the north-north-east. Several sets of later faults cut across the folds. As a result of folding, Aynak is divided into two prospects. The Central Aynak prospect is located on the shallow-dipping eastern limb of the anticline and the Western Aynak prospect occurs in the area of the periclinal closure at the western end of the structure (Figures 2 and 3).

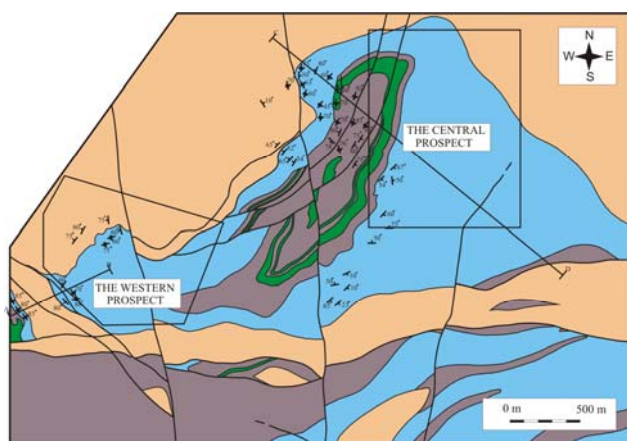


Figure 2. Simplified geological map of the Aynak area.

4 MINERALISATION

The mineralisation at Aynak is stratabound and consists of disseminated bornite and chalcopyrite hosted within a cyclic succession of metamorphosed dolomites, marls, siltstones and carbonaceous pelites of the Loy Khwar Formation. Primary mineral zonation is apparent with the central part of the deposit containing mainly bornite, grading out to chalcopyrite, then pyrite and pyrrhotite. Cobalt concentrations, although very low, increase towards the periphery of the deposit. The host sediments were deposited in Vendian-Cambrian times in a shallow sea on the northern margin of Gondwana.

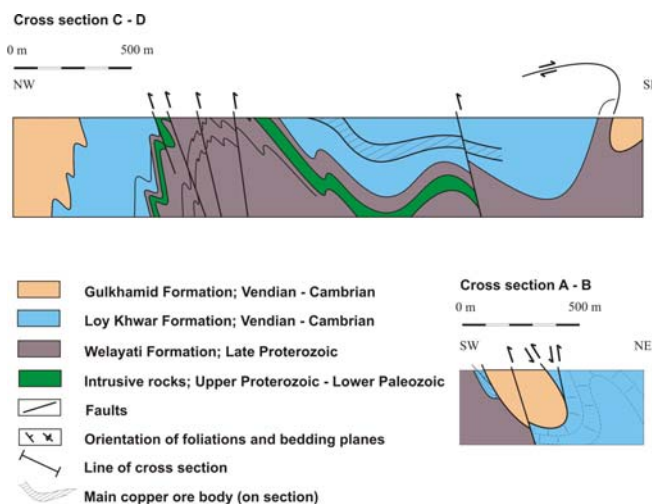


Figure 3. Simplified cross sections through the Aynak area.

5 METALLOGENIC MODEL

Detailed studies into the genesis of the deposit have yet to be carried out. However, due to the style, size and grade of the deposit at Aynak, it may be analogous to the deposits of the Zambian Copperbelt. A metallogenic model is proposed in which the copper is leached from underlying volcanic rocks by circulating evaporitic brines and seawater. The heated brines are channelled up marginal faults into the overlying sediments where they reacted with reduced interstitial fluids and hydrocarbons, depositing copper sulphides in the dolomite host rock (Figure 3).

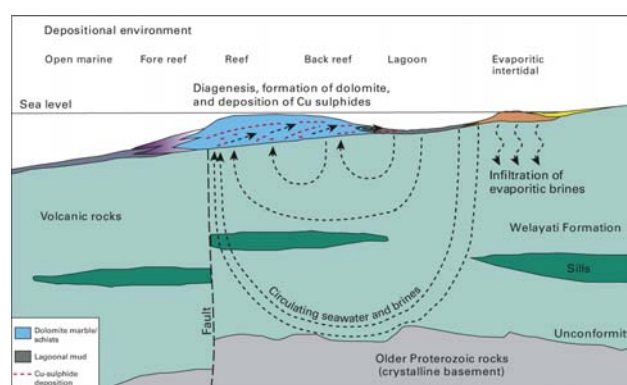


Figure 3. Proposed metallogenic model for the formation of copper mineralisation at Aynak.

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