

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

*Antony J Benham*¹ (abenham@bgs.ac.uk)

*Stan Coats*¹ (jSCO@bgs.ac.uk)

*Peter Kováč*² (geolpeto@savba.sk)

*Gill Norton*¹ (gen@bgs.ac.uk)

¹ British Geological Survey, Keyworth, Nottingham, UK

² Geological Institute Slovak Academy of Science, Bratislava, Slovakia

ABSTRACT

The Aynak copper deposit, located 30 km south of Kabul in Afghanistan (Figure 1), was discovered by Soviet geologists in the 1970s. Extensive exploration undertaken in the area between 1974-80 included several hundred boreholes, seventy trenches and nine exploratory adits. This work identified a “drill-indicated resource” of 240 Mt at 2.3% Cu (ESCAP, 1995).

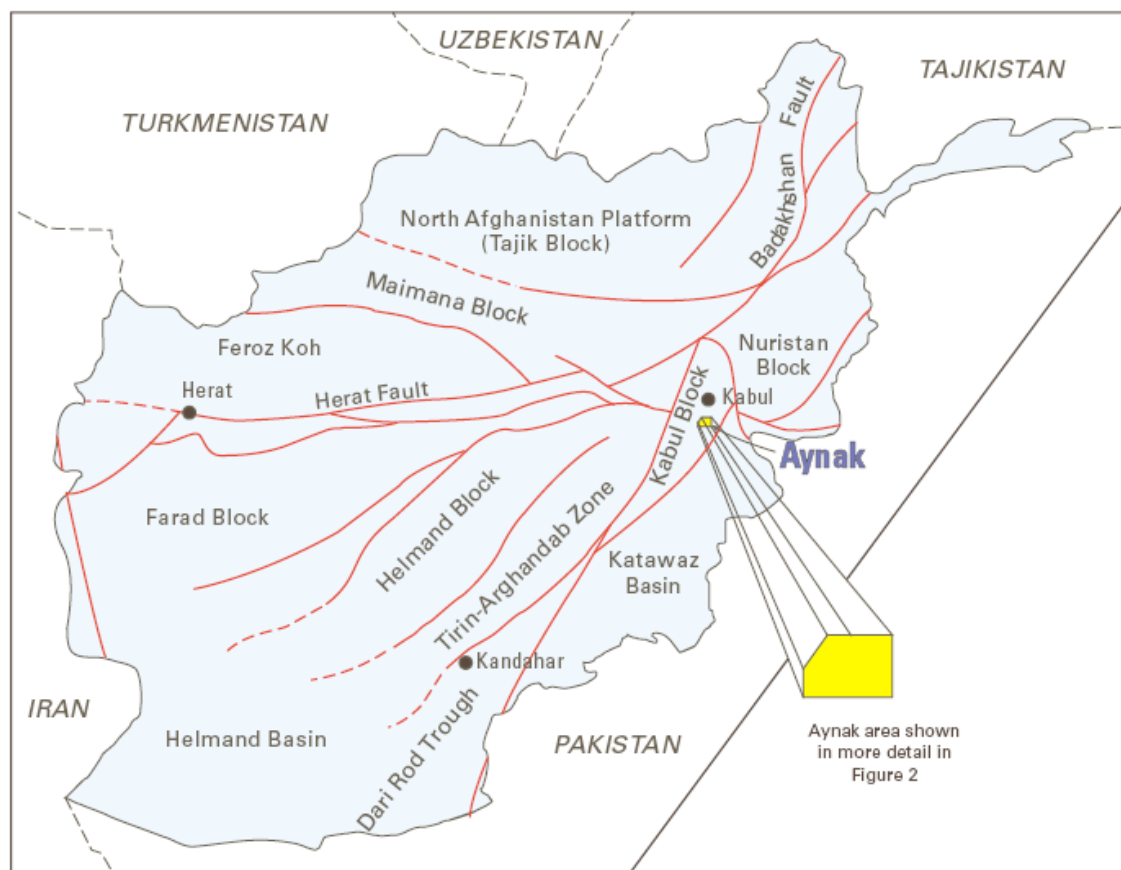
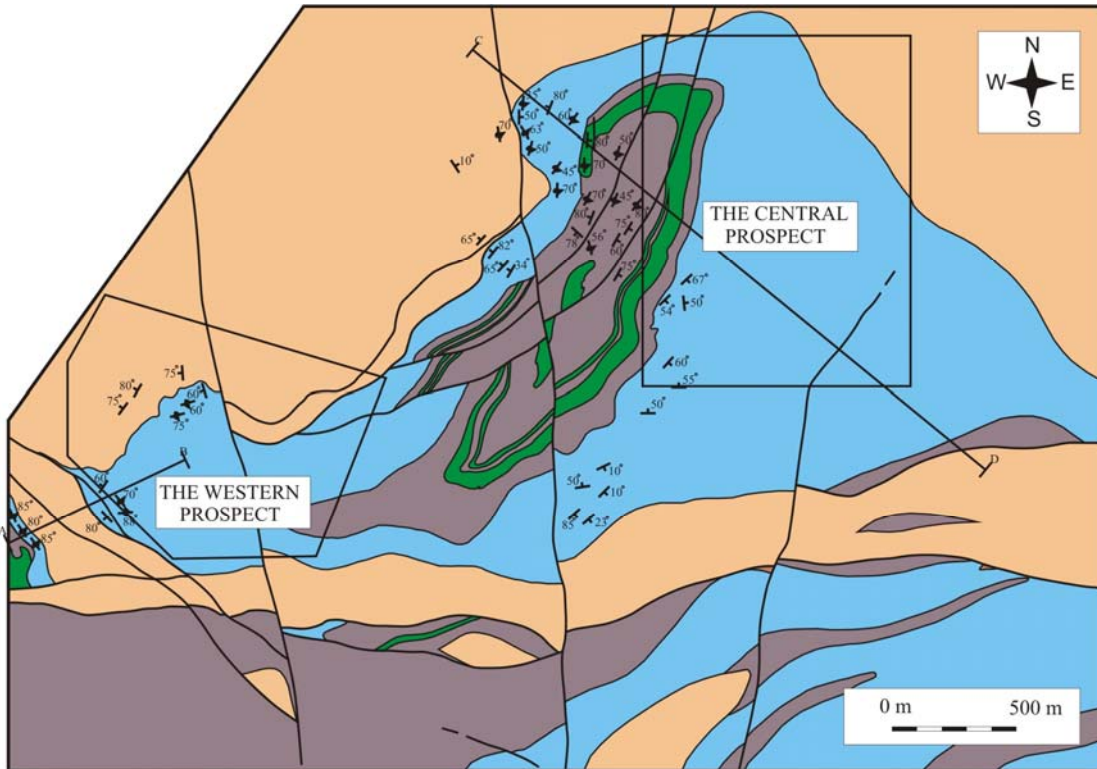


Figure 1. Structural map of Afghanistan and location of the Aynak copper deposit.

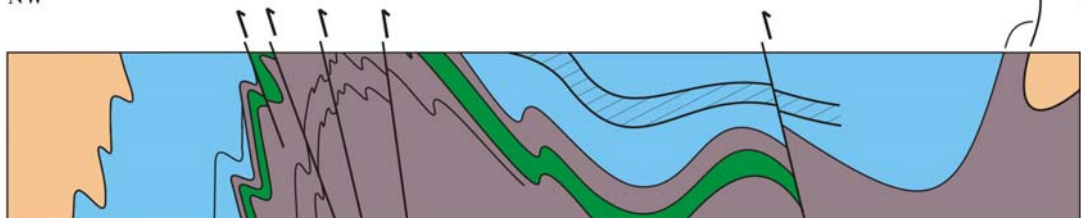
The structure at Aynak is dominated by the Aynak anticline. The anticline is asymmetrical and approximately 4 km in length and up to 2.5 km wide. The south-eastern limb dips gently to the south-east but the north-western limb is steeply dipping and in places overturned, with dips of 45-70° to the south-east. 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 (Figure 2).



Cross section C - D

0 m 500 m

NW



SE

- Gulkhamid Formation; Vendian - Cambrian
- Loy Khwar Formation; Vendian - Cambrian
- Welayati Formation; Late Proterozoic
- Intrusive rocks; Upper Proterozoic - Lower Paleozoic
- Faults
- Orientation of foliations and bedding planes
- Line of cross section
- Main copper ore body (on section)

Cross section A - B

0 m 500 m

SW



NE

Figure 2. Simplified geological map and cross sections of the Aynak area.

The mineralisation at Aynak consists of disseminated bornite and chalcopyrite, mainly concentrated in a stratabound orebody in a cyclic succession of metamorphosed dolomites, marls, siltstones and carbonaceous

pelites. The Vendian-Cambrian age sediments were deposited in a shallow sea on the northern margin of the Gondwana supercontinent.

Original resource estimations carried out by Soviet geologists, at varying cut-off grades, delineated several large ore bodies and a number of smaller lenses. At a 0.4 % Cu cut-off grade, the main orebody at Central Aynak extends 1850 m along strike and 1200 m down dip and has a maximum thickness of 210 m. At Western Aynak the main body extends 2230 m along strike and 1640 m down dip, and has a maximum thickness of 214 m, based on a similar cut-off.

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 (Figure 3).

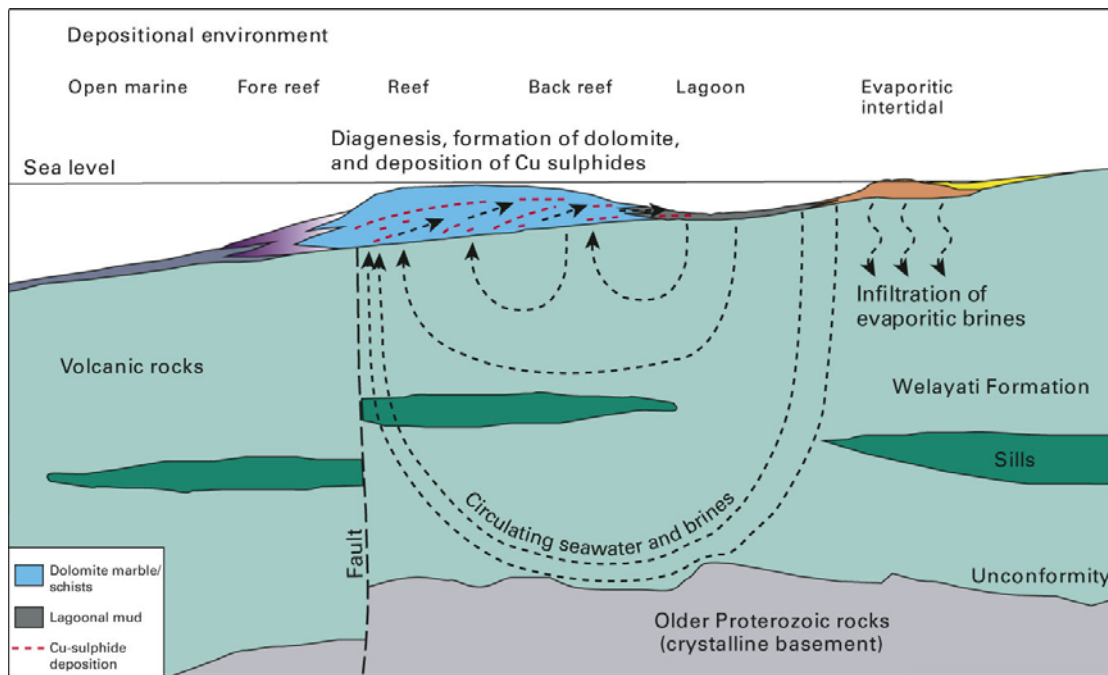


Figure 3. Possible metallogenic model for the formation of copper mineralisation at Aynak.

Reference

1. ESCAP, 1995. Atlas of Mineral Resources of the ESCAP Region: Geology and mineral resources of Afghanistan, Vol. 11. 1995 United Nations 85pp.