

ASPECTS OF NATIVE COPPER

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INTRODUCTION

Most Australian mineral collectors will have at least one fine specimen of native copper in their collection. Usually the specimen will be from an Australian location but also, within a comprehensive collection, there will be specimens from overseas particularly one of the famous coppers of the Keweenaw Peninsula, Michigan.

DISTRIBUTION

Most copper deposits will contain native copper particularly if they have a well developed oxide zone as is found in many of the outcropping or near surface fault hosted copper lodes in the semi-arid regions of Australia. A number of factors determine the extent of the oxide zone and the secondary minerals developed including the extent of the primary species from which they were derived, host rock, groundwater reactivity and rate of surface erosion.

Native copper is usually found in most abundance at the top of the supergene zone, the zone where the value of the lode is increased by the presence of ore high in copper content usually chalcocite, Cu_2S . This zone is often referred to as the "*chalcocite blanket*". It is situated at the water table. Native copper is deposited from groundwater enriched by the minerals mobilised by oxidation of the primary sulfides. This deposition of native copper can be by a number of potential chemical routes including directly by oxidation of primary ore, at a later stage by reduction of cuprite and also, as noted by G. M. Schwartz, by the reduction of chalcocite. At Globe, Arizona, he noted chalcocite being replaced by native copper invading fractures (Schwartz, 1934).

This is not to say that native copper will not be found in other zones of the lode. As land surfaces erode the water table descends and the supergene zone will usually follow. Native copper is relatively resistant to oxidation and if massive it will remain as a remnant slowly oxidising over a very long period. Large slugs of native copper were found on bench No.1 at the Great Australia mine, Cloncurry. Also, commonly found near the surface were thin sheets of native copper sandwiched within fractures in protective quartz. However, the native copper would have been formed originally at a much greater depth.

At some deposits native copper is relatively common whilst at other deposits which may appear similar it is scarce. This may be due to less being precipitated responding to geochemical conditions (Williams, 1990; Garrels, 1965) or eventual oxidation of the native copper to other copper species.

Whilst development of native copper in the oxide zone is the main topic of this discussion it should be noted that the famous deposits of native copper, in Precambrian basalt flows on Keweenaw Peninsula, Michigan, are primary (Freeman, 1964). The copper at Keweenaw often occurred in large sheet-like masses. Historical accounts refer to a copper rock "*three canoes long*" resting on the side of a river. A single 460 tonne mass was reported from the Minnesota mine (Palache *et al*, 1944). This locality is also famous for native silver often found associated with or as inclusions in copper.

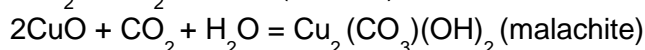
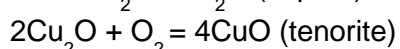
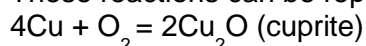
The author is not aware of any Australian deposit similar to those in Michigan. However, the small (up to 1 mm) native copper crystals occasionally found in the zeolite bearing basalt at Cairns Bay, near Flinders, Victoria, are of primary origin (Hall, 1989). There is a historical account of a hand size specimen of native copper found in basalt near Melbourne.

OXIDATION OF NATIVE COPPER

Native copper is often found with a reddish coating of cuprite and, in some instances, also covered with brilliant red cuprite crystals. The oxidation may end here but when in larger masses a sequence of reactions may result in a core of native copper having a rind of red cuprite, Cu_2O , often followed by black tenorite, CuO , and finally green malachite, $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$, occasionally with a little blue chrysocolla for good measure. This progressive oxidation is mostly found on native copper situated near the surface.

Wire-like specimens of native copper may oxidise to malachite at times with cuprite as an intermediate step. Some particularly attractive cabinet size specimens were collected a few years ago at Mineral Hill by John Chapman.

These reactions can be represented simply:



Note that in the above equations copper in cuprite is Cu^{1+} and in tenorite Cu^{2+} .

FORMS AND HABIT

A great attraction of native copper is its diversity in form and crystal habit which can not only show diversity from different localities but also within the one deposit.

George Smith appreciated this quality of native copper and collected many fine specimens including, during the 1890s, a group from the Proprietary Mine, Broken Hill. Whilst usually thought of as a silver, lead and zinc deposit, many fine copper specimens have been collected from Broken Hill.

Mount Elliott, situated 90 km south of Cloncurry, has produced fine specimens of native copper from early last century and during the last campaign of mining at the end of the century. W. H. Corbould, mine manager 1909 – 1917, described vughs with native copper : - *"In many of the larger ones, some of them 15 feet from floor to roof ,metallic copper as bright as newly minted pennies appeared, sometimes like bunches of grapes"* (Hore-Lacey, 1981).

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April 2008