TEXTURAL AND *IN-SITU* ANALYTICAL CONSTRAINTS ON THE PROVENANCE OF SMELTED AND NATIVE ARCHAEOLOGICAL COPPER IN THE GREAT LAKES REGION OF EASTERN NORTH AMERICA

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In-situ (μg-mg, ~1 mm) AMS analysis, as practiced with high-current Cs^+ ion sources, permits the characterization of small crystals and sherds of rare or valuable samples. These include small slivers of metallic articles, such as copper or brass, snipped from inconspicuous loci on archaeological metal artifacts. Samples from a project in which instrumental neutron activation (INAA) of ~200-mg aliquots is the standard bulk -analytical method (Hancock *et al.* 1991), were re-examined using a combination of wavelength-dispersive electron microprobe (10-element WDS-EPM) and AMS methods. Metal shavings were mounted in two polished formats: 1) thin sections with 20 2–5-mm slivers, suitable for metallographic study and EPM, and 2) sets of 12 sherds and standards in thick circular mounts, also suited to AMS of precious metals (Wilson *et al.* 1994). The samples are metal artifacts from the Great Lakes region, principally Ontario and Minnesota, plus native Cu (mineral specimens) from the Keweenaw Peninsula of northern Michigan. AMS ^{14}C dating (Beukens *et al.* 1992) indicates that some projectile points date to as old as 7,000 yr BP. Examination of 11 coppers suggested a rapid optical method of distinguishing artifacts made from native Cu *versus* smelted (trade or kettle) copper imported from Europe. Five samples of native copper were visually homogeneous and free of inclusions. The six "smelter" coppers contain high but variable numbers of spheroidal cuprite (Cu_2O) blebs, generally 1–10 μm in diameter, indicative of incomplete separation of oxide slag from copper metal. Similar features were encountered in a later survey of 68 mm-scale slivers of other artifacts. Practical minimum detection limits (MDL) for the EPM are ~200–1000 ppm. This is far higher than ppb (PGE, Au) to ppm (Au, Ag) levels found for trace elements by AMS, so the data obtained are complementary but not directly comparable. EPM data are especially useful for microchemical typing (Zn, Sn, As) of associated brass trade items. The "sourcing" of coppers was confirmed by PGE-Au-Ag data obtained by AMS on 9 samples. Smelted Cu has higher Ag (±Pt) and much higher Au than native Cu. This is consistent with INAA data, which show that a suite of trace elements (Au, Ag, Sb, As) can reliably separate the copper types.

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