METEORITIC METAL BEADS FROM THE HAVANA, ILLINOIS, HOPEWELL MOUNDS: A SOURCE IN MINNESOTA AND IMPLICATIONS FOR TRADE AND MANUFACTURE.

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Introduction: The Hopewell Horizon is the material remains of groups of people that lived throughout the Middle Woodland Period (400 BCE – 400 CE). Known primarily as mound builders, some of the mounds that dot the Ohio and Illinois River Valleys record their presence. The Hopewell collected, traded, and used for both practical needs and ornamentation a broad array of exotic materials collected from throughout North America, including obsidian from (what is now) Yellowstone, silver from Ontario, copper from Michigan, mica from the Appalaichans, and shells from the Gulf of Mexico.

Iron meteorites were among the exotic materials used by the Hopewell culture. These were fashioned into beads, awls, axes, adzes, and earspools and thin sheets that covered a variety of objects such as copper earspools [1,2]. In many cases, the meteoritic material is either too weathered or rare for destructive analyses that would allow a definitive link to a known meteorite. In other cases, meteorites recovered from mounds (e.g., Oktibbeha County; 58.5 wt.% Ni) are compositionally unlike any known meteorite. Meteoritic metal beads from the Hopewell Mounds in southern Ohio have been linked to the abundant, well-known Brenham pallasite of southern Kansas [3].

Twenty-two meteoritic beads were recovered from burial 10 of Havana, Illinois Mound 9 [4], which dates to ~400±250 BCE [5], and were reported to be unlike any meteorite known before 1976 [6]. Here, we reexamine potential links between the Havana bead and known meteorites and discuss implications for both trade routes and manufacturing techniques.

Havana, Illinois: We examined two of the 22 beads, including those studied by [6,7]. Both beads are characterized by a prominent, but strongly deformed, Widmanstatten pattern (Fig. 1) with kamacite bandwidths of ~0.25 mm. An axial cut perpendicular to the central hole reveals a flattened structure that appears to have been rolled around an object to produce the bead. Weathering has produced a rind around the bead, filled in the central hole and preferentially attacked kamacite. Metallographically, kamacite is characterized by substantial recrystallization, kamacite-taenite boundaries are serrated, and schreibersite is heavily brecciated. Analysis by [8] revealed a Ni concentration of 11.4 wt.% Ni and a grouping with IIICD irons.

Fig. 1 Havana bead (left) in cut parallel to central hole and bead made from Anoka (right) during this study with cut perpendicular to central hole.

Comparison to known meteorites: Within the IAB complex (which includes the formerly-designated group IIICD), irons with ~11 wt.% Ni are known, but not particularly common. Three North American irons – Carlton, Anoka and Edmonton (Kentucky), found in Texas, Minnesota and Kentucky, respectively – are broadly similar in composition to Havana. All three were known and dismissed as potential sources for Havana by [6] for the obvious reason that each was known as only a single mass which exhibited no evidence of any cold-chiseling or removal of material. Indeed, Anoka was found buried well beneath the surface of the ground. In the past decade, several additional masses of Anoka have been recovered, proving that Anoka was a shower of iron meteorites and prompting us to reconsider Anoka as a possible source for Havana.

We conducted optical microscopy, SEM elemental and phase mapping, electron microprobe analyses, LA-ICP-MS and INAA analyses of Havana and Anoka for comparison. Anoka and Havana are petrologically similar with similar kamacite bandwidths (0.35±0.05 vs. 0.25±0.05 mm), the presence of schreibersite, presence of M-shaped Ni zoning profiles, and similar major element compositions as determined by electron probe analyses (11.4 wt.% Ni, 0.63 wt.% Co). Metallographic differences – namely the absence of duplex plessite and the recrystallized state of the kamacite in Havana – have been attributed to cold-working and reheating [7]. Trace element compositions are also remarkably similar for a variety of elements analyzed by LA-ICP-MS and INAA (Fig.

2). Minor element differences are attributable to heterogeneous distribution of schreibersite (explaining W, P and Ag in the LA-ICP-MS analyses) or selective loss of kamacite by weathering (evident in INAA data by slightly low Co and elevated trace elements). The remarkable mineralogical, metallographic and chemical similarities between the Havana bead and Anoka leave little doubt that the Anoka meteorite was indeed the source material for the manufacture of the Havana bead.

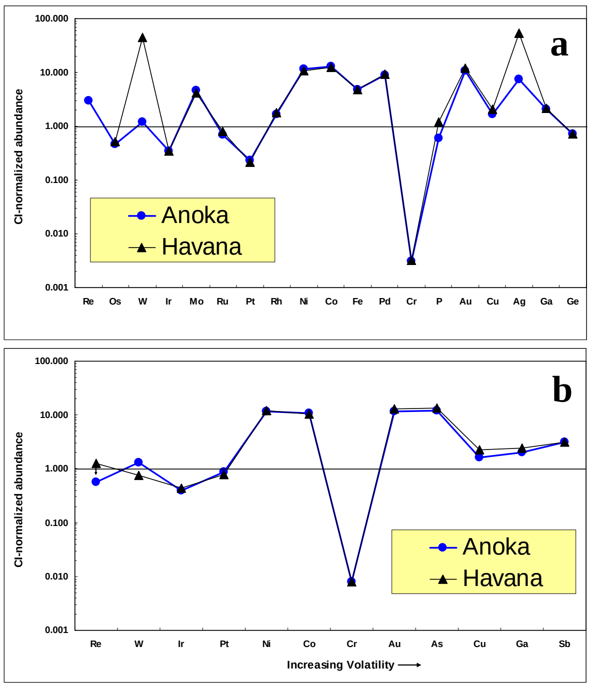

Fig. 2 CI-normalized elemental abundances for Anoka and Havana from (a) LA-ICP-MS traverses and (b) bulk INAA. The two samples are compositionally similar, with differences in W, P and Ag by LA-ICP-MS reflecting differences in schreibersite abundance and minor differences in INAA reflecting preferential weathering of kamacite.

Manufacturing: To further refine the history of the bead, we undertook both controlled laboratory simulations and a bead-making experiment using only materials available to the Hopewell (lithics, bone, wood-burning fire) using pieces of Anoka recently acquired by the Smithsonian. Controlled experiments with heating to 500-700ºC for 3 hours produced metallographic textures similar to Havana when the bead was first cold-worked and then heated to 700ºC, including kamacite recrystallization and serrated kamacite edges. Taenite retains the M-shaped Ni compositional gradient and duplex plessite. Our anthropological experiment likewise produced a remarkably similar bead (Fig. 1) with repeated heating in the fire to temperatures estimated at ~400-500ºC followed by cold-working between lithics. The rounded shape was achieved by indentation into a grooved rock, followed by hammering the bead around a green stick. Metallographically, the bead made by us from Anoka retains the M-shaped Ni profile and plessite is only modestly recrstyallized, suggesting that manufacture of this bead may have required temperatues lower than those estimated by [7], but with repeated cycles of heating and cold-working. The dominant mechanism for flattening the bead was likely kamacite recrystallization during cold-working. Small pieces of Anoka were likely liberated from a larger mass by fracturing brittle schreibersite-rich zones.

Hopewell trade routes and the paleohistory of Havana: Although it is clear that the Hopewell collected and utilized exotic material from throughout North America, it has been less clear how these materials were acquired and transported. The idea of a Hopewell Interaction Sphere has been widely accepted [9], where cultural centers exchanged materials. Alternatively, expeditions to well-known, plentiful sources to acquire materials might also occur, such as in the case of the western obsidians or, perhaps, the Brenham pallasite. In the case of Havana, the raw material was likely a single mass of the Anoka iron that was found by local inhabitants and traded. How did that trade ultimately transport the bead from central Minnesota ~750 km to central Illinois? Although Hopewell centers are present within ~40 km of the Anoka find site, these are small and probably lacked metal-working technology. The centers at Havana, Illinois, also are not thought to be major centers of metal-working technology. It seems likely that the Anoka iron was traded to a metal-working center in Ohio or Michigan, where metalsmiths skilled at working copper and/or silver applied the same techniques to the much harder iron meteorite, producing beads that were then traded to the Havana center, where they were placed in an earthen burial mound some 2,300 years ago.

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