SMALL IMPACT CRATERS ON SIKHOTE-ALIN IRON METEORITE SURFACES

M. Killgore[1] and J.F. McHone[2], [1]Southwest Meteorite Laboratory, PO. Box 95, Payson AZ 85547, [2]Dept of Geology, Arizona State University, Tempe AZ 85287-1404

Introduction: Existing reports of the abundant and well studied Sikhote-Alin Iron meteorite attribute delicately preserved surface features to aerodynamic sculpturing, effervescence of volatile components, or plucking of xenoliths. Newly available individual and fragmented irons occasionally display single, round-floored circular depressions with high-relief rims. We interpret these features as impact craters sustained during the last moments of a specimen in flight.

Background: On the clear, cold morning of 12 February 1947, a brilliant fireball was seen over the Sikhote-Alin Mountains of eastern Siberia and, in less than ten seconds, more than 50 tons of iron meteorites slammed into uninhabited, snow covered taiga forest.

Formal expeditions began arriving almost immediately so that, over the next several years, more than 100 impact pits and craters have been charted, more than 30 tons of pristine irons have been collected, and a uniquely preserved, bountiful collection of cosmic material has become accessible for systematic scientific scrutiny [1.2].

Breakup and Fusion: The original Sikhote-Alin Iron bolide, a coarsest octahedrite, began fragmenting high within the atmosphere along weaker internal planes defined by crystal boundaries. Recovered specimens occur mostly in three distinct geomorphic forms: larger masses bounded by recognizable geometric planes and usually with defined regmaglypts; twisted and jagged, shrapnel-like fragments with occasional regmaglypts or partial fusion crusts; and most commonly, small, irregularly shaped individuals completely sheathed in a distinct high-gloss metallic fusion crust. Fusion crusts on all geomorphic forms commonly are decorated with delicately sculptured patterns which include swirls of grooves and ridges, adhered or “spattered” metal beads, patches of scoriaceous froth and bubbles, and occasional pits or shallow holes with angular walls. A thick ground cover of snow, estimated to be at least 60 cm deep during the impact event, has been credited with cushioning the impact landing of smaller pieces and preserving their delicate surfaces. Most of these features are readily attributed to processes accompanying high-velocity atmospheric flow: erosion of weaker components, frictional heating, volatilization, and plucking of single crystals.

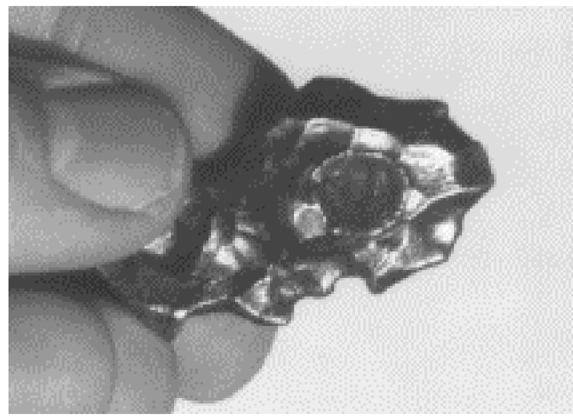

Fig 1. A small whole individual Sikhote-Alin iron meteorite with well developed fusion crust and a solitary 8 mm diameter impact crater on its surface.

Impact craters: During an examination of newly available, small (ca. 100 g) individual and fragmented Sikhote-Alin Irons we have observed an unreported type of surface morphologic feature. Solitary, round-floored circular depressions 1 - 8 mm in diameter and ringed by high-relief rims occur on fusion-crusted individuals and on at least one shrapnel fragment. We interpret these features as impact craters resulting from high velocity collisions between meteoritic particles during the latest stages of atmospheric flight. Although crater-like bubbles might develop within a fusion crust, during skin heating by atmospheric friction, craters emplaced on fusion-free shrapnel fragments had to have formed later, after atmospheric penetration had already violently disrupted a larger body.

References: [1]Krinov, E.L., 1966. *Giant Meteorites*, Pergamon,397 p. [2]Krinov, E.L., 1960. *Principles of Meteoritics*, Pergamon,535 p.