# SURFACE CRATERS ON SIKHOTE-ALIN IRONS; IMPACT PRODUCED.

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**Introduction:** Recent collecting expeditions into the Sikhote-Alin strewnfiel have produced several individual and fragmented irons decorated with round-floored circular depressions surrounded by high-relief rims. Previous reports attribute most delicate surface features to aerodynamic sculpturing, effervescence of volatile components, or plucking of xenoliths. We interpret some of these features as impact craters sustained during the final moments of a specimen in flight.

**Background**: On the morning of February 12, 1947, a brilliant fireball appeared in the clear sky over the Sikhote-Alin Mountains of eastern Siberia and, in less than 10 seconds, more than 50 tons of Fe 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 had been charted, more than 30 tons of pristine irons had been collected, and a uniquely preserved, bountiful collection of cosmic material had 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 heat, volatilization, and plucking of single crystals.

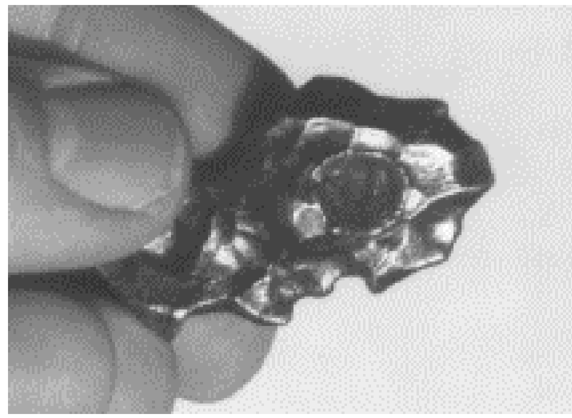

**Fig 1.** An individual Sikhote-Alin iron meteorite with well developed fusion crust and an 8 mm diameter impact crater on its surface.

**Impact craters**: During an examination of newly available, small (~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. Local contitions during the Sikhote-Alin event included thousands of Fe projectiles infalling into an environment already populated with high-speed Fe and rock ejecta fragments from craters still being formed on the ground.

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