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# The fall of Hoima, an H6 chondrite from Uganda

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**Abstract**–The Hoima meteorite fell on March 30, 2003, in the Hoima district near Butema, Uganda. According to its mineralogy, texture, and mineral chemical characteristics, Hoima is classified as a brecciated H6 ordinary chondrite of shock stage S2 and weathering grade W0. After the meteorites Maziba, Soroti, Awere, and Mbale, Hoima represents the fifth meteorite recorded from Uganda.

## INTRODUCTION

In the last decade, a large number of meteorite finds—especially from north-African and Arabic deserts—were added to our meteorite collections. However, an observation and later recovery of a meteorite fall still remains a rare and fascinating event. Here we report on the fall of the Hoima meteorite in Uganda, which represents the fifth meteorite found in this country after Awere, Maziba, Soroti, and Mbale (Koblitz 2005).

## THE FALL

The Hoima meteorite fell on Sunday, March 30, 2003 at about 1:00 P.M. (local time) in the Hoima district near the town of Butema along the Hoima-Kampala road (Fig. 1). After the fall had been reported and the first sample handed over by the locals to an employee of the Department of Petroleum Exploration, a field trip was organized by the Geological Survey and Mines Department of Uganda to trace the impact localities and to recover as much as possible of the meteoritic material (Baguma and Kigereigu 2003). According to the report from this field trip, the fall was witnessed by many local people and was accompanied by an explosive sound still audible at a distance of about 35 km from the find locations (Baguma and Kigereigu 2003). Based on the eyewitness reports, the meteorite most probably broke up into several pieces that fell at different places. Four of these suspected fall locations were visited by the field party: Kyohairwe (two places), Kidukuru, and Kifumura. At Kyohairwe and Kidukuru neither the exact places where the meteorite fell could be located nor material could be recovered. At Kifumura the chairman of the local primary school, Mr. Deo Karuhanga, gave a detailed report on the fall and led the party to the impact locality (Baguma and Kigereigu 2003). According to him, at first nimbus-like clouds appeared above the place. The meteoroid sounded three times in the clouds and hit the ground near a specific grass-thatched house. The rock was about 20 cm in diameter and rested in an oval-shaped hole that was several inches deep. No fireball, smoke, or other side effects were seen. People aware of the fall were greatly terrified and thought the black material was a bomb that had been dropped (Baguma and Kigereigu 2003). Mr. Deo Karuhanga reported the meteorite fall first to Lt. Connell Kaganda and, finally, to the Butema police post. Following a first inspection by the police and an employee of a construction company, the rock was finally dug out by a military escort and brought to Lt. Connell Kaganda (Baguma and Kigereigu 2003). This stone measuring about 10 × 15 cm quickly disappeared, whereas a later, smaller find, a 5 × 5 cm sized sample weighing 167.70 g, was handed to the Geological Museum at Entebbe. The large, lost meteorite fragment landed at 1°21′45.60″, 31°28′22.60″; the smaller recovered sample originated from 1°20′42.00″, 31°28′22.00″.

## FIRST OBSERVATIONS

The first investigations of the meteorite were conducted at the Geological Survey and Mines Department of Uganda

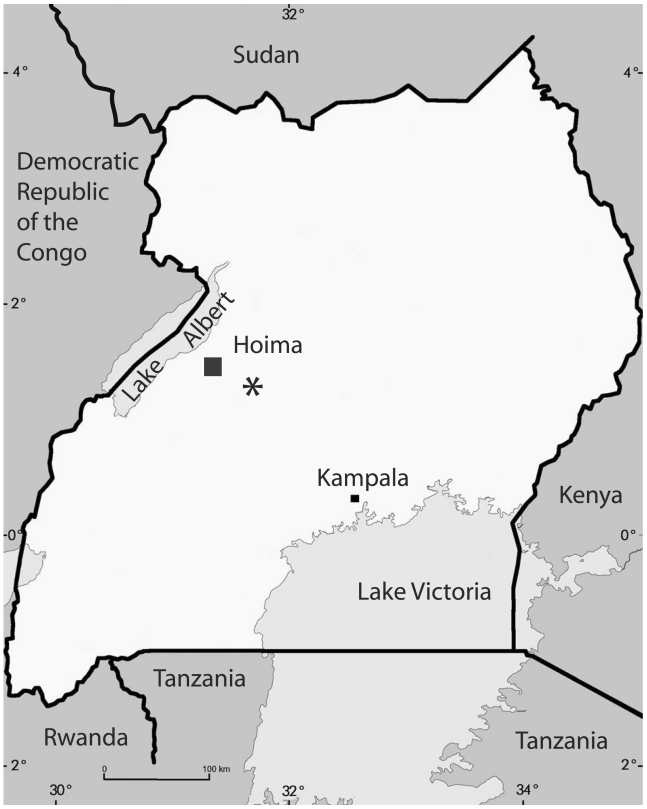


Fig. 1. A sketch map of Uganda and neighboring countries showing the location of the Hoima meteorite fall (star).

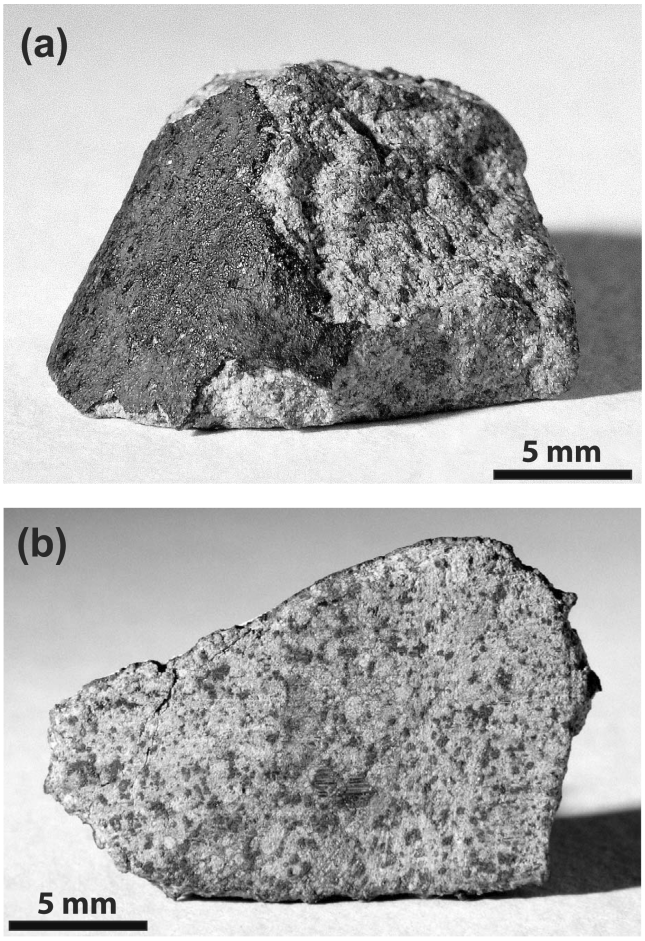


Fig. 2. A small fragment of the Hoima meteorite showing the black fusion crust (a) and the grayish interior (b).

(Baguma and Kigereigu 2003). The specimen is largely covered by a black fusion crust. The interior of the meteorite appears grayish with the sawn face showing reddish brown patches indicative for oxidation of magnetite (Baguma and Kigereigu 2003, Fig. 2). The rock appeared strongly magnetic, was found to be nonradioactive, contains sulfides, and has a density of 3.26 g/cm$^3$ (Baguma and Kigereigu 2003). The study of a thin section by optical microscopy revealed a porphyroblastic texture with weak foliation and olivine, orthopyroxene, and opaque minerals as main constituents (Baguma and Kigereigu 2003). Due to the recognition of chondrules, the meteorite was classified as a chondrite. A chip and a thin section were given to one of us (M. D.) for further detailed investigations and final classification.

## SAMPLES AND ANALYTICAL TECHNIQUES

One polished thin section of the Hoima meteorite with a total area of about 6.5 cm$^2$ was investigated at the Berlin facility by optical and scanning electron microscopy (JEOL JSM-6300). Quantitative mineral analyses were performed with a JEOL JXA-8800L electron microprobe operated at 15 kV, a probe current of 15 nA, and a beam size of 1 µm. Suitable mineral standards including anorthoclase, basaltic glass, chromite, chromium augite, diopside, ilmenite, microcline, and plagioclase, all certified by the United States National Museum as reference samples for electron microprobe analysis (Jarosewich et al. 1980), were applied to calculate the mineral compositions.

## PETROGRAPHY AND MINERAL CHEMISTRY

Generally, the Hoima meteorite is a breccia composed of slightly lighter and darker chondritic lithologies (Fig. 3a). Optical and electron microprobe investigations, however, revealed that all lithologies show the same texture and that the constituent minerals have the same chemical composition (Figs. 3b and 4). Overall, the Hoima meteorite shows a granoblastic texture with most areas being highly recrystallized (Fig. 3b). Few chondrules—especially cryptocrystalline and less abundant porphyritic olivine, porphyritic olivine-pyroxene, and olivine barred types—are still visible but mostly poorly defined (Figs. 3b and 4). Major mineral phases of the meteorite are olivine, orthopyroxene, feldspar, and Fe,Ni metal (dominantly kamacite), and minor phases include chromite, troilite, and merrillite. Representative electron microprobe analyses of the main

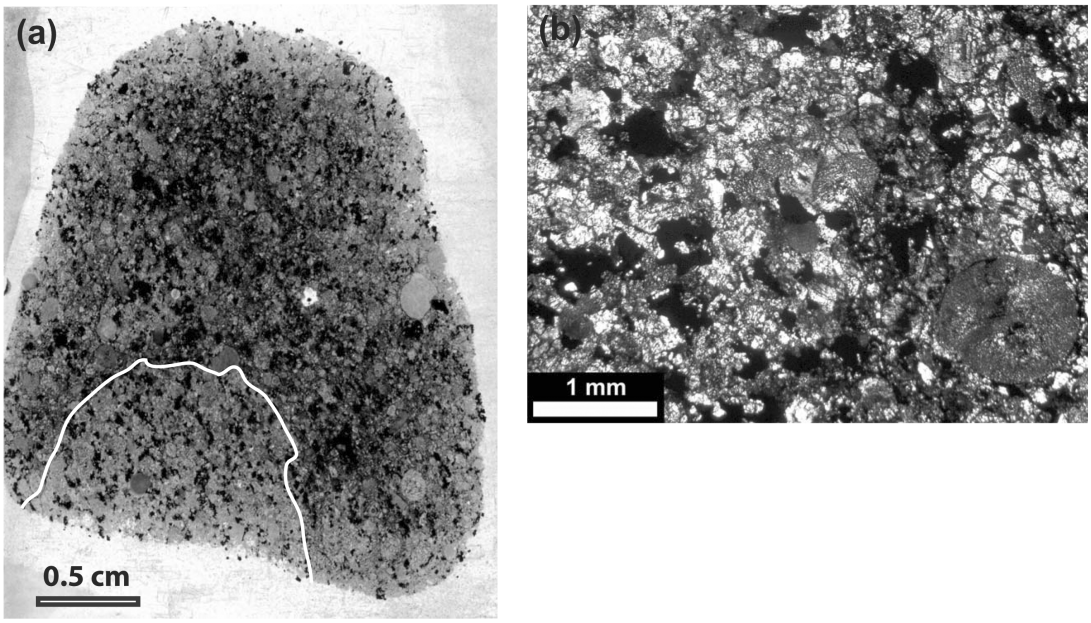


Fig. 3. a) A scan of the entire thin section of the Hoima meteorite used in this study illustrating the overall texture and the brecciated nature of the meteorite. The dotted white line marks a brighter fragment. b) An optical micrograph showing the dominantly recrystallized texture with few poorly defined chondrules in Hoima (plain polarizer).

silicate phases are given in Table 1. Olivine and pyroxene are homogeneous in composition throughout the entire sample, attesting to almost complete equilibration. The mean fayalite content in olivine is 17.4 ± 0.5 mole% and the mean ferrosilite content in low-Ca pyroxene is 15.4 ± 0.9 mole% (Wo = 1.2 ± 0.2 mole%), which means that Hoima belongs to the H group of ordinary chondrites (Van Schmus and Wood 1967). Homogeneity of the olivine and low-Ca pyroxene composition as well as the dominantly recrystallized state of the meteorite texture are indicative for the petrologic type 6 of ordinary chondrites, finally leading to a H6 (breccia) classification for the Hoima meteorite.

Mineral phases in the Hoima chondrite generally display the weakest observable shock effects (Stöffler et al. 1991): olivine shows undulatory extinction and nonplanar irregular fractures, the small and rare feldspar grains display undulatory extinction, and low-Ca pyroxene is also characterized by undulatory extinction and irregular fractures. According to the shock classification of Stöffler et al. (1991), the shock stage S2 should be assigned to the Hoima meteorite.

As expected for a fresh meteorite fall and already suggested by the dominantly grayish color of the sawn surfaces (Fig. 2b), the Hoima meteorite displays basically no signs of weathering in thin section. All metals and sulfides are completely preserved and free of oxide rims. An occasionally observed brown staining very likely developed due to the contact with liquid water during sample preparation, or due to humid climatic conditions in the fall region. According to the weathering scale of Wlotzka (1993), Hoima is of weathering grade W0.

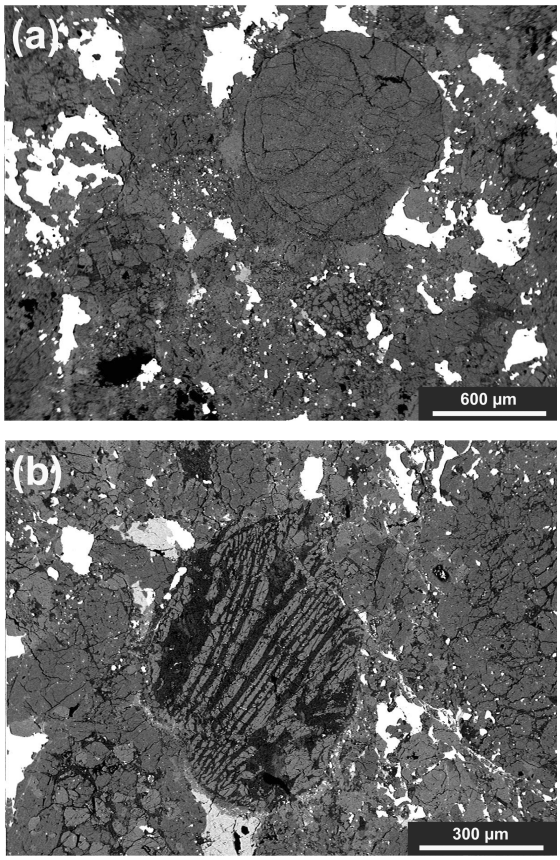


Fig. 4. Backscattered electron images showing (a) a cryptocrystalline and (b) a barred olivine chondrule as well as poorly defined porphyritic olivine and porphyritic olivine-pyroxene chondrules (a and b).

Table 1. Representative electron microprobe analyses of silicates from the Hoima meteorite.

| | Olivine | Olivine | Pyroxene | Pyroxene | Feldspar | Feldspar |
|---|---|---|---|---|---|---|
| $SiO_2$ | 39.5 | 39.4 | 56.6 | 56.4 | 63.3 | 64.8 |
| $TiO_2$ | <0.04 | 0.05 | 0.19 | 0.09 | <0.04 | 0.07 |
| $Al_2O_3$ | <0.01 | 0.02 | 0.1 | 0.21 | 23.1 | 22.3 |
| $Cr_2O_3$ | <0.03 | <0.03 | 0.09 | 0.08 | <0.03 | <0.03 |
| FeO | 15.6 | 16.0 | 9.8 | 11.0 | 0.62 | 0.53 |
| MnO | 0.48 | 0.49 | 0.5 | 0.47 | <0.03 | 0.04 |
| MgO | 44.1 | 43.8 | 31.8 | 31.0 | 0.06 | <0.01 |
| NiO | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| CaO | 0.03 | <0.02 | 0.7 | 0.53 | 2.86 | 2.33 |
| $Na_2O$ | <0.03 | <0.03 | <0.03 | <0.03 | 9.0 | 8.3 |
| $K_2O$ | <0.04 | <0.04 | <0.04 | <0.04 | 0.9 | 2.02 |
| Total | 99.86 | 99.88 | 99.85 | 99.85 | 99.94 | 100.43 |
| Fa | 16.6 | 17.0 | | | | |
| Fs | | | 14.5 | 16.0 | | |
| Wo/An | | | 1.4 | 1.0 | 14.3 | 11.8 |
| Ab | | | | | 80.5 | 76.1 |

Data in wt%.
n.a.: not analyzed.

## CONCLUSIONS

1. The Hoima meteorite fall was witnessed by several local people on Sunday, March 30, 2003, at about 1:00 P.M. (local time) in the Hoima district near Butema. While the first stone measuring about 10 × 15 cm was apparently lost, a smaller one, initially weighing 167.70 g, was later found and given to the Geological Museum in Entebbe. The 20.8 g specimen classified by us was cut from this mass and is retained in the meteorite collection of the Museum für Naturkunde in Berlin.
2. According to its mineralogical, textural, and mineral chemical characteristics, the Hoima meteorite is classified as a brecciated H6 ordinary chondrite. Very weak shock effects in the constituent minerals relate to a shock stage S2, and completely preserved metals and sulfides indicate a weathering grade W0.
3. After the meteorites Maziba (L6; September 24, 1942), Soroti (ungrouped iron; September 17, 1945), Awere (L4; July 12, 1968), Mbale (L5/6; August 14, 1992), Hoima represents the fifth recorded meteorite from Uganda.

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*Editorial Handling*—Dr. Edward Scott

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