The Dergaon (H5) chondrite: Fall, classification, petrological and chemical characteristics, cosmogenic effects, and noble gas records

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Abstract–A multiple fall of a stony meteorite occurred near the town of Dergaon in Assam, India, on March 2, 2001. Several fragments weighing <2 kg and a single large fragment weighing ∼10 kg were recovered from the strewn field, which extended over several tens of square kilometers. Chemical, petrographic, and oxygen isotopic studies indicate it to be, in most aspects, a typical H5 chondrite, except the unusually low K content of ∼340 ppm. A cosmic ray exposure of 9.7 Ma is inferred from the cosmogenic noble gas records. Activities of eleven cosmogenic radionuclides were measured. 26Al and 22Na activities as well as the 22Na/26Al activity ratio are close to the values expected on the basis of solar modulation of galactic cosmic rays. The low 60Co activity (<1 dpm/kg) is indicative of a small preatmospheric size of the meteorite. Cosmic ray heavy nuclei track densities in olivine grains range from ∼10^6 cm^−2 in samples from the largest fragment to approximately (4–9) × 10^5 cm^−2 in one of the smaller fragments. The combined track, radionuclide, and noble gas data suggest a preatmospheric radius of ∼20 cm for the Dergaon meteorite.

INTRODUCTION

A multiple fall of a stony meteorite occurred in the eastern region of the state of Assam, India, on March 2, 2001, at 16:40 local time. The fall was visible over a distance of approximately 40 km, stretching from the river island of Majuli to west of the town of Dergaon (Fig. 1). The largest fragment, weighing 10.3 kg, was recovered in the village of Balidua (26°42′N, 93°51′E), a few kilometers west of Dergaon. Eyewitnesses observed a fireball accompanied by two loud detonations and mild tremor. The largest fragment fell in a sugarcane field, forming a crater approximately 40 cm in diameter and 60 cm deep. Additional smaller fragments were recovered in the village of Koilaghat (one piece weighing ∼1.4 kg) and two fragments, each weighing <1 kg, were recovered in Majuli. It is possible that other fragments fell in the Brahmaputra River channels present in the area of the fall. Preliminary mineralogic and petrographic studies suggested that the meteorite belongs to the H5 group (Grossman and Zipfel 2001). In this paper, we present the results of a detailed study of the mineralogy, petrography, and chemical composition of this meteorite along with cosmogenic radioactivity, noble gases, and nuclear track records.

SAMPLES AND EXPERIMENTAL APPROACH

Nuclear track records were studied in several spot samples from the two largest fragments recovered in Balidua and Koilaghat. An additional sample from the Balidua fragment was analyzed for noble gas records. Broad physical characteristics of the meteorite were inferred from visual and microscopic observations of these fragments. Mineralogical and petrological characterizations are based on studies of polished thin sections made from several samples from the main fragment. Data on mineral chemistry was obtained using a JEOL JXA-8600M superprobe. Instrumental neutron activation analysis (INAA), inductively coupled plasma atomic emission spectroscopy (ICP-AES) and atomic absorption spectroscopy (AAS) techniques were used to obtain bulk composition of the meteorite. Clean fragments (~2.5 g) from the interior of the meteorite were crushed and powdered in an agate mortar. Two aliquots, each ~200 mg, were dissolved in HF-HCl for ICP-AES/AAS analysis.