Analysis of the Statesboro, Georgia shock-darkened L5 chondrite.

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In August 2003, Statesboro, Georgia farmer Harold Cannon brought an unusual rock to the Department of Geology and Geography at Georgia Southern University. There are few naturally occurring rocks on the coastal plain of Georgia, so by definition, any rock found there is “unusual”. However, this particular specimen turned out to be not only unusual, but otherworldly.

In mid-June, 2000 Cannon was harvesting a crop of butter beans when his mechanical bean picker pulled the rock up from his field. In the process, yellow paint from the device was deposited on the specimen. Cannon removed the rock and tossed it between a pair of produce freezers under a shed in his back yard. For more than 3 years the rock sat exposed to the elements. When Cannon was cleaning the area around the shed in summer 2003, he finally decided to find out exactly what the rock was. He said he suspected it might be a meteorite because it was heavier than expected for its size, and after breaking off a small fragment, he noticed it was very dark inside.

Our initial microscopic examination and thin section analysis at Georgia Southern University indicated that the 2.3-kg-specimen was most likely a shock-darkened ordinary chondrite, probably an L-type of petrographic grade 4-6 based on mineralogy, metal abundance, and alteration of the chondrules (Kelley *et al.* 2004). XRD analysis of the meteorite revealed olivine, orthopyroxene, and metal compositions indicative of an L-chondrite as well. Electron microprobe analysis of minerals in the Statesboro type specimen were performed at the Smithsonian Institution and revealed “very middle of the road compositions” for L-chondrites. The results showed an olivine composition of $Fo_{75.4}$ and an orthopyroxene composition of $En_{77.4}$ $Fs_{20.8}Wo_{1.8}$. Major, minor, and trace element data based on XRF analysis performed at Franklin and Marshall College also confirmed the high metal content of the sample. On the basis of these data we filed a report through the Meteoritical Society (Russell *et al.* 2004) to propose the name “Statesboro” for this meteorite in December 2003. We also answered questions from the media (e.g. Bragg 2003) and issued a press release through Georgia Southern University.

Electron microprobe analyses of minerals in a second chip of the Statesboro meteorite were performed at the University of Georgia and also yielded olivine ($Fo_{74.6}$), orthopyroxene ($En_{77.1}Fs_{21.2}Wo_{1.7}$), metal, and suphide compositions well within the range for L5 chondrites. To date all of the feldspar probed in the second chip appears to have been converted to glass (maskelynite), which confirms the shocked nature of the specimen. Two phosphates, chlorapatite and merrillite, have also been identified in this sample.

The concentrations and isotopic composition of light noble gases were measured at the Max Planck Institute in Mainz, Germany, while a sample of ~130 mg was dissolved at the University of California, Berkeley, for analysis of cosmogenic radionuclides (10Be, 26Al, 36Cl and 41Ca). After chemically isolating these radionuclides from the dissolved sample, their concentrations were measured at the Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory.

As in many shocked L chondrites, Statesboro shows very low concentrations of radiogenic 4He and 40Ar, which indicate a major impact event on the L-chondrite parent body, less than 500 Myr ago. The measured concentrations of cosmogenic 3He, 21Ne, 38Ar yield a cosmic ray exposure (CRE) age of 5.1 +/- 0.4 Myr if we use the production rate formalism of Eugster (1988) and the measured 22Ne/21Ne ratio of 1.074. This age coincides with a cluster at ~5 Myr that is mainly observed for L5 and L6 chondrites with low radiogenic 40Ar (Marti and Graf, 1992).

The high concentrations of 36Cl and 41Ca (due to neutron-capture reactions) and low 10Be (~19 dpm/kg) indicate that the Statesboro meteorite had a larger pre-atmospheric size than most chondrites. We estimate that the Statesboro meteoroid had a radius of ~50-80 cm and weighed several tons. For such large objects the 22Ne/21Ne ratio is not a reliable indicator of shielding, leading to overestimation of the noble gas production rates. We therefore used the method of Graf et al. (1990), which is based on relatively constant 10Be/21Ne and 26Al/21Ne production rate ratios. This method yields a more reliable CRE age of 7.0-7.5 Myr.

The exterior of the meteorite exhibits a 2-3 mm thick orange-colored rind due to terrestrial weathering. Chemical analysis of this rind shows strong depletions (70-80%) in Mg and Ca relative to less mobile elements such as Al and Fe. These depletions are similar to those observed in extremely weathered meteorites from Roosevelt County, New Mexico (Bland et al. 1998), which show terrestrial ages >40,000 y. Measurements of cosmogenic 14C are in progress at the University of Arizona, Tucson, to determine the terrestrial age of the Statesboro meteorite.

The Statesboro meteorite is the twenty-third meteorite and the fourth L-chondrite to be found or seen to fall in Georgia. It is interesting to note that the other three Georgia L-chondrites are all L6's. The geographically nearest, previous meteorite to Statesboro was the Claxton, Georgia fall. That 1.4-kg-L6 chondrite smashed a mailbox on December 10, 1984. To date there is no scientific evidence to support previous speculation by Povenmire (2004) that the Claxton and Statesboro meteorites are connected. Not only are they different petrographic grades, but the Statesboro specimen is heavily shocked and darkened. In contrast the Claxton meteorite is relatively unshocked, and no other fragments were reported seen during, or found following that fall event. An immediate precursor connection between these two meteorites can be confidently ruled out.

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