

## **Shock and Awe: Collisions and Heating in the Early Solar System**

### **Abstract**

Planets, moons, asteroids and comets formed by low-velocity collisions of smaller objects known as planetesimals, which were heated to various degrees by poorly-understood processes. Recent research suggests that the energy released during higher-velocity collisions could have been a major heat source during the early solar system. Meteorites are samples of ancient planetesimals that never accreted into larger objects, and thus provide a window into the earliest stages of planet formation. Here, I am proposing to assemble a research team composed of three faculty and two students to study meteorites available from PSU's Cascadia Meteorite Laboratory collection. This work will help answer questions about heat sources, heating conditions, and deformation in the early solar system.

### **Introduction**

The solid bodies (planets, moons, asteroids and comets) of our solar system accreted from smaller objects known as planetesimals, which were heated to various degrees by poorly-understood processes. One proposed heating mechanism is the heat released when objects collide (collisional or shock heating), which also results in deformation. Chondrite meteorites are samples of the ancient planetesimals that never accreted into larger objects, and thus provide a window into the earliest stages of planet formation. In this proposal, I am requesting funds to analyze chondrites available in PSU's meteorite collection to help answer questions about heat sources and heating conditions in the early solar system. Specifically, funds are requested to continue various projects that are partly underway involving collaborative research activities by three PSU faculty (myself, Dr. Rick Hugo, Dr. Melinda Hutson) and two undergraduate students. The main interim goal is to obtain data that can be used to develop a proposal requesting external funding from NASA. The ultimate goal of the proposed research would be to provide constraints on the role and conditions of shock heating and deformation in the early solar system.

### **Meteorites Selected for Further Work**

The meteorites chosen for this study (CML 0109, CML 0110, CML 0175, CML 0272, CML 0273, CML 0288, CML 0358, and CML 0422) display characteristics indicating they were shock heated and deformed under various conditions. Five of these meteorites have not yet been classified (see sub-project 1). Currently, undergraduate students are involved in projects on two of the meteorites (CML 0175 and CML 0272) included in this proposed study. Obvious shock effects are seen in hand specimen images of a third chondrite (CML 0110) that was partly shock-melted, with streams of solidified impact melt surrounding remnant chondrite fragments (Fig. 1, see next page).