

(1) Visit to Yamaguchi University, Faculty of Science, Graduate School of Science and Engineering, Department of Earth Sciences Yamaguchi City, September 10 - December 8, 2000

Associate Professor, Michael R. Rampino

Earth & Environmental Sciences Program, New York University, New York, New York, 10003, USA, and NASA, Goddard Institute for Space Studies, New York, New York, 10025, USA

世話教官：理学部・化学地球科学科助教授 三浦 保範

Introduction

My working relationship with Prof. Y. Miura goes back several years. We met in Japan in 1997, and have been corresponding since that time about our common interests in shock-wave physics and shocked materials. In September 1999, I was invited to attend the International Symposium on Planetary Impact Events and their Consequences on Earth (PIECE 1999) held in Yamaguchi and organized by Prof. Miura. At that time, I also participated in field trips to Takamatsu Crater in Kagawa Prefecture, Shikoku, the Triassic-Jurassic geologic boundary section at Inuyama, and the Permian-Triassic geologic boundary at Sasayama. On these trips, we made a preliminary sampling of the geologic boundaries and the materials at Takamatsu crater. It was very good, therefore, to have the opportunity to return to Yamaguchi University to work with Prof. Miura, and to continue our joint studies on impact materials formed by shock waves.

We spent a very productive three months, in which we visited Takamatsu Crater twice for field studies, prepared thin sections from samples we collected, and analyzed materials from the crater by polarized light microscopy, x-ray diffraction, and SEM methods. Prof. Miura organized an International Forum on Investigations of the Earth (IFIE 2000) on November 24, and invited Dr. David King, Jr., from Auburn University, Auburn, Alabama USA, a leading specialist on impact



craters and impact materials at geologic boundaries. A field trip in which we visited and sampled Takamatsu Crater, and the Permian-Triassic boundary section at Ubara was organized for Nov. 25 to 27 following the IFIE meeting.

Research

The main topic of our joint researches was impact materials formed by shock waves on the Earth. We focussed specifically on two problems: (1) Takamatsu Crater, a suspected meteorite impact crater in Kagawa Prefecture, Shikoku, and (2) Search for shocked material at geological boundaries in Japan, namely the Permian-Triassic boundary (251 million years ago) and the Triassic-Jurassic boundary (201 million years ago) marked by global mass extinctions of life that might have been caused by impacts of large asteroids or comets.

Takamatsu Crater is a buried crater defined by a 4 km diameter negative gravity anomaly, and zeolitized glassy breccias (fragmental rocks) containing many fragments of fractured granite and fresh and altered glasses. The crater was previously interpreted as a volcanic caldera, but the breccias with granitic inclusions, are more characteristic of shock melting processes at impact craters.

We prepared a number of thin sections from samples of the breccias and melt fragments at Takamatsu, and of the granites located on the exposed SE rim of the buried crater, and we have been working on these materials. We discovered highly fractured granitic fragments, with possible planar deformation features (PDFs) indicative of shock-wave effects. The Rhyoke Granite surrounding the crater shows features of severe shattering and shear, suggesting very violent phenomena such as expected from an impact.

Remote sensing data and compilation of geophysical data from the crater area are being used by Dr. Miklos Kedves (a post-doctoral student working under Prof. Miura) to help define the crater dimensions and the processes involved in the formation of the crater. Although the original crater diameter, based on the gravity study, was estimated to be ~4 km, our studies suggest an outer ring at ~8 km diameter in the Rhyoke Granite bedrock. This work has implications for exploration for petroleum and natural gas at buried impact sites.

Materials produced by impact shock waves include shocked quartz and other minerals, high-pressure silica polymorphs (e.g., stishovite), impact-melt glass, microspherules of various kinds, and Ni/Fe grains. We are searching for such evidence of shocked minerals and/or extraterrestrial geochemical markers at the Triassic-Jurassic and Permian-Triassic mass-extinction boundaries. In our studies, we analyzed material from the T-J boundary in the Inuyama sections, and thus far have found some spherule-like grains that require further study. Samples from the Sasayama Permian-Triassic section taken last year were analyzed by our colleagues at the University of Hawaii who discovered fullerenes (60C and 70C) of possible extraterrestrial origin. The fullerenes apparently trapped rare gases (He, Ne, Ar) of non-atmospheric composition within their cage-like structure, suggesting a meteoritic component, and possible impact event, at the Permian-Triassic mass extinction event. Such trapping of atoms in fullerene "cages" may have valuable technological applications.

Teaching, students, education

During my stay at Yamaguchi, I presented several lectures on earth and space science to Prof.

Miura's classes, made a presentation to new students that generated interest to pursue research in this area. I also gave a seminar in the Earth Science Department on impacts and shock effects. The IFIE Meeting was attended by a large group of students from Yamaguchi University, and I presented several talks on our research in Japan and elsewhere. In the field, I worked with students who are doing research on Takamatsu Crater, and on spherules from the Niho Meteorite shower site. In the laboratory, we taught the students to recognize various features diagnostic of shocked materials under the petrographic microscope.

Summary

I spent a very productive three months in Yamaguchi, and enjoyed my stay and work at Yamaguchi University enormously. This was made possible by the great efforts of Prof. Y. Miura in organizing research, field trips and the International Forum meeting. I am very grateful for the financial support and to Dr. H. Hironaka, President of Yamaguchi University, the Director of VBL, and the Dean of the Faculty of Science for accepting me as an employee of the Venture Business Laboratory. I hope that we can continue this fruitful collaboration, and that I can invite Prof. Miura to spend time in New York. I also hope that we can continue plans to create an exchange program for faculty and students in various disciplines between New York University and Yamaguchi University.

(2) My visit of Yamaguchi University, Process Design Engineering Laboratory, Department of Chemical Engineering, March, 2001

Professor Wen-Yih Chen

Department of Chemical Engineering, National Central University, Chung-Li, Taiwan

世話教官：工学部・応用化学工学科教授 山本 修一

Introduction

It is really honored and great pleasure for me to have this visiting opportunity to Yamaguchi University and Prof. Shuichi Yamamoto's laboratory. This visiting opportunity provided by Prof.