Kakenhi and Me

Eiji Ito
Professor Emeritus, Okayama University

Since I took up my first job in 1969 as a research associate at what was then the Okayama University Institute for Thermal Springs Research, my research work has attempted to reproduce in a laboratory setting the high pressure and high temperature conditions that exist deep within the Earth, in order to carry out a synthesis of the substances that exist there and elucidate their physical properties. I suppose it was the experience I gained as a graduate student using the Kawai-type multi-anvil high pressure apparatus (KMA) that led me to work in the field of high-pressure earth sciences.

The first project I was involved in used a special budget of five million yen from the Institute and five million yen of a Grant-in-Aid for General Scientific Research (B) obtained by my employer, the late Professor Takashi Matsumoto, to build and install at the laboratory high-pressure apparatuses that could cope with loads of up to 1,400 tons and 250 tons. In 1972, we got off to an extremely promising start with the first of these two machines, and were the first in the world to demonstrate the synthesis and reactions of magnesium silicates, which are extremely important for understanding the constitution of the earth's mantle. The nature of the research meant that stable production of extremely high pressures was key to the continued viability of the project.

Producing high pressures depends on concentrating a mechanically produced force onto a small amount of sample materials via hard materials (tungsten carbide, WC). Securing a constant supply of high-quality tungsten carbide therefore imposes a heavy burden in terms of cost. In the beginning, it was possible for us to continue our work because the Institute for Thermal Springs Research had a relatively smooth source of funding as a research facility affiliated to the Ministry of Education, Science, Sports and Culture. But the situation gradually became more difficult, especially after Professor Matsumoto passed away. It was in these

uncertain circumstances that the applications I had made every year for Kakenhi funding since taking up my appointment were finally accepted in 1976 as a Grant-in-Aid for Encouragement of Young Scientists (A). It was with great emotion and gratitude that I took up the grant. At the time, I thought the academic society operated a little like a closed guild, and had assumed that there was little chance that a researcher like me, with no academic credentials and without an impressive track record, would receive funding.

In 1978, Okayama University received a budget allocation of 75 million yen for a 5000-ton high-pressure apparatus (USSA5000). I know that this came about thanks to not only the hard work of everyone in the institute and the relevant department at Okayama University, but also thanks to the vital support of outsiders such as the late Professor Shunichi Akimoto. We were the third university in Japan to obtain an apparatus of this size, following Osaka and Nagoya Universities, and I knew I needed to use this machine to come up with good results. I knew that failure was out of the question now. In my first experiment, the entire tungsten carbide parts turned to dust and around 120,000 yen disappeared in an instant. I felt a wave of anxiety about the future. However, the equipment came with a support budget of around 1.7 million yen per year, and on top of this an application led by the late Professor Ichiro Sunagawa for a Grant-in-Aid for Special Project Research was accepted for 1978–79. This enabled us to settle down and start to make the most of the true capabilities of the USSA5000. Thanks to Grants-in-Aid for General Scientific Research (B) in 1983–85 in the name of Yoshito Matsui, for General Scientific Research (C) in my name in 1983, and for Special Project Research in the name of Professor Fumiyuki Marumo for 1985–86, we were able to operate the USSA5000 smoothly and produce results at regular intervals. As a result, our applications for Kakenhi funding started to become more successful. In particular, a Grant-in-Aid for General Scientific Research (C) to me and Eiichi Takahashi in 1988–89 allowed us to publish about 30 papers for a grant allocation of 1.9 million yen. At last, I felt I had fulfilled my responsibilities.

It was around this time that research institutes affiliated with national universities were reorganized as part of the Japanese government' administrative reform and in 1985 our institute became the Institute for the Study of the Earth's Interior (ISEI). As a result, our regular operating budget decreased dramatically, and there seemed to be no prospect that the budget allocations we had been receiving for large-scale

equipment almost every other year since the 1970s would now continue. One of the pieces of equipment that were essential for our research was an electron probe microanalyzer (EPMA) used for chemical analysis of the micro-sized sample. We had been using the same equipment since 1972 and it was now past its lifetime usage limit. We had no option but to depend on help from manufacturers' labs and from researchers at other universities, but the situation was far from ideal. In fiscal 1992, together with Eizo Nakamura, one of ISEI's up-and-coming geochemists, I applied for a Grant-in-Aid for Specially Promoted Research for a project with the title, "Revealing the Early Differentiation and Evolution of the Earth Centered on Separation of the Core." We received generous support from many directions and in early summer of that year we heard an unofficial announcement that our proposal had been accepted. However, this was canceled almost immediately. Luckily, applications for the same subject were approved for four consecutive years from the following year for almost the entire amount we had requested. As a result, we were at last able to introduce a secondary ion-microprobe mass spectrometer (SIMS) and an EPMA to the lab. These two pieces of equipment are still functioning well today, and the electron probe microanalyzer is used widely by researchers from other institutions. This Grant-in-Aid for Specially Promoted Research allowed us to carry out high-pressure experiments using sintered diamond (SD), which is more than twice as hard as WC, and allowed us to lay down the foundation for pressures of 100GPa and higher produced by the KMA at present.

From then on, super-high-pressure experiments using high-cost SDs became essential to our high pressure Earth sciences research. A number of grants-in-aid for scientific research made it possible to continue with this work. In 2001, thanks to the newly introduced Grant-in-Aid for Scientific Research (S) category of funding, it became possible to undertake steady X-ray observational experiments using the SPring-8 synchrotron radiation facility, allowing us to produce distinctive results under precise high-pressure conditions. In these ways, my work has become inextricably linked to Kakenhi over the course of my career.

The budget for Kakenhi in fiscal 2016 is considerably more than 200 billion yen. I remember visiting the relevant department at the Ministry of Education, Science, Sports and Culture in 1992 and seeing a banner posted above the department manager's desk, on which someone had written "Let's aim for a Kakenhi budget of 100 billion yen!" It makes me realize how much time has passed since then. As well

as additional concentrated investment such as for Grants-in Aid for Specially Promoted Research and Scientific Research (S), Kakenhi has also increased its funding for Grants-in-Aid for Young Scientists and for Challenging Research, thus providing indispensable support for the development of original and creative science and technology in the future. I hope that Kakenhi will continue to provide much-needed donations for a healthy academic future amid ongoing social change.