SOURCE AMERICAN JOURNAL OF SCIENCE

VOLUME	NUMBER	DATE	PAGES (Inclusive)
254		Dec. 1956	722 - 735

THIS MATERIAL IS COPYRIGHTED AND MAY BE USED ONLY FOR STUDY AND RESEARCH. FURTHER REPRODUCTION PERMITTED ONLY IN ACCORDANCE WITH SCI 1156.

A SIMPLE APPARATUS FOR HIGH PRESSURES AND TEMPERATURES*

D. T. GRIGGS and G. C. KENNEDY

ABSTRACT. A simple apparatus, based on the principle of Bridgman's shearing apparatus, provides pressures of 80 kilobars at 500°C, 50 kb at 800°C, and 20 kb at 1000°C. Pressure is known within approximately 5 percent, and temperature to 5°C. The sample, in powdered form, is compressed between two pistons which are externally heated and pressed together by a hydraulic jack. Under certain circumstances water vapor pressure in the sample may equal total pressure, even at high temperatures. The apparatus is extremely easy to use, and equilibrium seems to be attained more rapidly than in the case of pure hydrostatic pressure. Thus, it seems well adapted for study of metamorphic reactions within the range of pressure and temperature to be expected normally in the outer 50-100 kilometers of the Earth.

INTRODUCTION

Bridgman (1935) was the first to make quantitative experiments on a sample compressed between two flat piston faces. He showed theoretically (1937) that, to a first approximation, the stress system in such a compressed disk is hydrostatic except for a thin peripheral region (less than 5 percent of the radius in general). Hence the pressure over most of the sample is approximately equal to the force with which the pistons are pressed together, divided by the area of the piston face. Bridgman (1952, p. 177) later demonstrated that the pressure so calculated is equal to the actual pressure within "a few per cent" which was within the experimental error. This was done by measuring the electrical resistance of bismuth in an apparatus of this type. Its resistance changes sharply when bismuth undergoes a polymorphic transition at 24.9 kilobars at room temperature. The pressure at which this transition occurs had been previously determined by Bridgman in a conventional hydrostatic apparatus.

Larsen and Bridgman (1938) attempted to bring about mineral transitions in the shearing apparatus but encountered little success, as work was performed at room temperature. Griggs (1941) used apparatus of this type in experiments on metamorphic reactions at low pressures and moderate temperatures and had recently been using such an apparatus for experiments at 100 kb, room temperature. Kennedy suggested that the Bridgman apparatus might be adapted in such a way that mineral reactions might be explored at high temperatures and pressures and that water vapor might be retained. Hence, this cooperative project was undertaken. Experiments were started with a press on hand and pistons which had been acquired for work at room temperature, 100 kb. Later, apparatus more suitable to the purpose was constructed. The latest apparatus, familiarly known as the "simple squeezer," is described here.

* Publication no. 66, Institute of Geophysics, University of California, Los Angeles 24, California.

A report on research carried out under the auspices of the Office of Naval Research. Reproduction in whole or in part is permitted for any purpose of the United States Government.