

Pressless split-sphere apparatus equipped with scaled-up Kawai-cell for mineralogical studies at 10–20 GPa

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ABSTRACT

Pressless split-sphere apparatus (BARS) equipped with an 8-6 type multi-anvil system is used extensively for large (6 carats) gem quality diamond crystal growth and various mineralogical and geochemical studies at shallow mantle conditions ($P \leq 7.5$ GPa). In this study, we extend the pressure range for this apparatus to the conditions of the Earth's transition zone ($P = 20$ GPa) using a 6-8 multi-anvil system. A scaled-up Kawai-cell consisting of 47 mm WC cubic anvils with 10 mm truncation and 18 mm MgO pressure medium was employed for the experiments. A 300 mm spherical multi-anvil block compressed by a hydraulic system with 2500 atm capacity was used to compress the Kawai-cell. A pressure of 15.5 GPa was successfully generated at the oil pressure of 1875 atm. The comparison of the BARS apparatus calibrations with those obtained using a uniaxial split-sphere press USSA-5000 suggests that pressure up to 17 and 20 GPa in compressed cell/sample volumes of 1200/60 and 400/18 mm³, respectively, can be generated using a combination of the BARS apparatus and the scaled-up Kawai-cell. This cell volume is much larger than that in conventional multi-anvil systems, which does not exceed 80 mm³ at the same conditions.

Keywords: BARS, pressless split-sphere apparatus, Kawai-type apparatus, scaled-up Kawai cell, high-pressure apparatus, multi-anvil, 6-8 type, Earth's mantle