



Phase transition of CaCO_3 up to 200 GPa and 2600 K

S. Ono (1,2)

(1) Institute for Research on Earth Evolution (IFREE), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, JAPAN, (2) Now at Department of Earth Sciences, University College London, London, UK (shigeaki.ono@ucl.ac.uk / Fax: +44-20-7679-4166)

The behavior of carbonates at high pressures and temperatures has profound implications for the global carbon cycle in the Earth's interior. To understand the carbon circulation, we need to know the high-pressure behavior of Mg- and Ca- carbonates, because a large volume of carbonate rocks including both components sink into the deep mantle at subduction zones. Recent theoretical calculation on the behavior of carbonates predicted that both Mg- and Ca-carbonate will transform into a pyroxene-type structure [1]. However, no evidence of these high-pressure phases has been observed in high-pressure experiments. In this study, we conducted laser-heated diamond anvil cell experiments combined with X-rays from a synchrotron radiation source to acquire data on CaCO_3 phases at high pressures up to 200 GPa. The sample pellet was loaded into a motor-driven diamond anvil cell [2]. The experimental details were described elsewhere [3]. In our study, the pressure was increased directly to ~ 120 GPa at room temperature. After the desired pressure was achieved, the sample was heated to ~ 2000 K. We confirmed an orthorhombic phase, post-aragonite, reported in previous high-pressure experiments [4]. Next, the pressure was gradually increased to 140 GPa. We discovered a new high-pressure phase, and confirmed that the new phase was stable at least up to 200 GPa. The diffraction peaks of the new phase were assigned to a pyroxene-type structure having space group $C222_1$, which showed the Ca^{4+} cations exhibit a four-fold coordination. The stability of this new calcium carbonate implies that the carbon dioxide, which is trapped at the oceanic floor and dragged into the deep mantle by the subduction of oceanic plates, is storable at the base of the lower mantle. This may affect the interpretation of carbon circulation in the Earth's deep mantle.

[1] Oganov et al. (2006) EPSL 241, 95+ [2] Ono et al. (2007) JPCM 19, 036205 [3] Ono et al. (2005) EPSL 236, 914+ [4] Ono et al. (2005) Am Mineral 90, 667+