

학위논문 연구계획서

(학과 보관용)

연구 계획서 제 출 자		과 정	석사	학 과	지구천문대기학부(지구	학 기	4
		학 번	2019311491		성 명	윤서희 (인)	
논문 지도 교수		학과·직위			성 명	(인)	
연구 착수 예정일		2019년07월11일			연구 완료 예정일	2021년02월26일	
연구 제 목	국 문	근지표 온도 압력 하에서 망간 산화물의 상전이					
	영 문	Phase transitions of manganese oxide minerals under moderate hydrostatic pressures and temperatures					

Manganese oxide minerals are important indicators of planetary surface environments as they are redox sensitive and capable of water storage. Amongst them, birnessite and buserite are the two major components in manganese nodules on the ocean floor, composed of edge-shared MnO_6 octahedral sheets separated by $\sim 7 \text{ \AA}$ and $\sim 10 \text{ \AA}$, respectively. The arrangement and stability of cations-water assembly in-between the layers of buserite, however, has not been established yet. In this study, we show that buserite is a super-hydrated form of birnessite with ca. 17 wt.% more water. We compressed birnessite in a diamond anvil cell (DAC) using water as a pressure transmitting medium. At 0.25(10) GPa we found that the $\sim 7 \text{ \AA}$ layer spacing of birnessite expands to $\sim 10 \text{ \AA}$. A structural model of buserite derived from Rietveld refinement revealed that the central layer of disordered Na^+ cations and water molecules is sandwiched by additional water layers. Further transformation of buserite to manganite is induced above 1.8(1) GPa after heating at 150°C and then to hausmannite above 2.0(1) GPa after heating at 200°C . While buserite can be recovered as long as maintained in water medium, the latter transformations are irreversible, and the recovered samples reveal distinctive morphologies compared to birnessite. Further structural details have been derived from DFT calculations to show the evolution of hydrogen-bonded cation-water assembly from birnessite to buserite. We thus demonstrate that super-hydration occurs at the sub-surface conditions of the Earth and other planets and could be a novel means to store and transport water.

주임교수 귀하

(부족시 별지사용)