

## Swelling behavior of magnesium saturated smectites

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Smectite belongs to clay minerals formed in the presence of liquid water. Smectites are composed of 2:1 layer with tetrahedral sheet and octahedral sheet. Smectites are categorized to di-octahedral type (e.g., nontronite and montmorillonite) and tri-octahedral type (e.g. saponite). The interlayer between the sheets is occupied by hydrated cations. The interlayer cations are usually  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ . The distances of interlayer (basal spacing) depend on type of interlayer cations and relative humidity (RH). The basal spacing can change from 9 to 15 Å as function of amount of RH. At 0% of RH, basal spacings are around 10 Å when interlayer cation is  $\text{Na}^+$  or  $\text{K}^+$ . That is 12 Å when interlayer cation is  $\text{Ca}^{2+}$ . On the other hand, the basal spacings ranges from 11 to 14 Å when interlayer cation is  $\text{Mg}^{2+}$  (Sato et al, 1992; Morodome and Kawamura 2009).

Curiosity rover sent to the Gale crater on mars examines the possibility of existence of life and habitable environment (Vaniman et al, 2014). Water is essential for life. Therefore, in order to estimate possibility of life, it is important to know water quality. Gale crater is thought to be an ancient lake. Curiosity obtained the lacustrine sediment samples and analyzed the mineralogical and geochemical characteristics of the sediments. From the CheMin-XRD analyses, smectites were discovered in JohnKlein and Cumberland sites. The smectites are presumed to be saponite (Vaniman et al, 2014; Bristow et al, 2015). The basal spacing in Cumberland' s saponite exhibited 13.2 Å at RH0%. Now it has been under debates whether the interlayer cation in Cumberland' s saponite is  $\text{MgOH}^+$  or  $\text{Mg}^{2+}$  ion.

Suquet et al, 1975 showed that basal spacing of  $\text{Mg}^{2+}$  saturated saponite is 11.4 Å at RH0%. Therefore, Vaniman et al. 2014 and Bristow et al, 2015 presumed that the interlayer cation in Cumberland' s saponite is  $\text{MgOH}^+$  ion. However, basal spacing of some other  $\text{Mg}^{2+}$  saturated smectites exhibited above 13.2 Å. This study experimentally assess the basal spacing of smectites including saponite under several atomospheric compositions with  $\text{N}_2$ , air or  $\text{CO}_2$ .