IRON MICRO-XANES ANALYSIS OF ACHONDRITIC PLAGIOCLASE: IMPLICATIONS FOR THEIR REDOX STATES.

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Oxidation states of achondrites have important information about the redox states of their parent bodies. In our previous study, we estimated redox states of shergottites by using synchrotron radiation (SR) Fe-XANES measurement of maskelynite [1]. Because these samples are estimated to have formed at log-fO_2=IW+1~IW+3 [e.g., 2], comparison with other achondritic plagioclase will give better constrain on their redox states. In this study, we analyzed plagioclase in unbrecciated lunar mare meteorite (MIL05035: plagioclase is maskelynitized), angrite (D'Orbigny), and primitive achondrite (GRA06129) by SR Fe-XANES analysis at BL-4A, Photon Factory, KEK, Japan in order to relatively compare their redox states from $Fe^{3+}/\Sigma Fe$ ratios of plagioclase. The $Fe^{3+}/\Sigma Fe$ ratio was estimated using the method described in [3].

The $Fe^{3+}/\Sigma Fe$ ratios of maskelynite in MIL05035, plagioclase in D'Orbigny, and plagioclase in GRA06129 are estimated to be about 0.13, 0.17 and 0.50, respectively. The $Fe^{3+}/\Sigma Fe$ ratio of maskelynite in MIL05035 is the smallest among the samples studied, which is consistent with the reducing condition of mare volcanism. This is not so different from $Fe^{3+}/\Sigma Fe$=0.23 by [4] that reported the $Fe^{3+}/\Sigma Fe$ ratio of Apollo 15555 plagioclase. Plagioclase in D'Orbigny has slightly higher $Fe^{3+}/\Sigma Fe$ ratio than that of MIL05035. This is in agreement with the estimate that angrite formed at slightly oxidizing condition ($\log fO_2$~IW+1) [e.g., 5]. The fO_2 during metamorphic re-equilibration of GRA06129 is estimated to be $\log fO_2$~IW+2 [6], which is slightly higher than that of angrite. The obtained $Fe^{3+}/\Sigma Fe$ ratio of plagioclase in GRA06129 is indeed higher than that of D'Orbigny, thus consistent with the difference of estimated fO_2.

Geochemically-depleted and geochemically-enriched shergottites are estimated to have formed at about $\log fO_2$~IW+1 and IW+3, respectively [2]. Our previous SR Fe-XANES study showed that the $Fe^{3+}/\Sigma Fe$ ratios of maskelynite in geochemically-depleted shergotttites were about 0.2 and those of geochemically-enriched shergottites about 0.9 [1], respectively. The $Fe^{3+}/\Sigma Fe$ ratio of plagioclase and estimated fO_2 of D'Orbigny are both close to those of geochemically-depleted shergotttites. Thus, this study demonstrates that SR Fe-XANES analysis of plagioclase and maskelynite is useful for estimating redox states of achondrites as was suggested by [4]. Because the estimated $Fe^{3+}/\Sigma Fe$ ratio usually bears ~10% error due to different crystallographic orientation [e.g., 3], maskelynite is ideal for this estimate.

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