PYROXENE COMPOSITIONS IN EETA79001 LITHOLOGIES: COMPARISON WITH ZAGAMI.

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Introduction: Shergottites record history of martian volcanic activities. During the volcanic process, some kind of mixing event such as magma mixing and/or crustal assimilations may have occurred. Some shergottites include Zagami and Elephant Moraine (EET) A79001 contains several lithologies with different petrological signatures [1-4]. These differences are often constrained as fractional crystallization. In fact, these shergottites contains late-stage products of Fe-rich minerals (fayalite and/or hedenbergite) and K-rich melt pocket. Pyroxene grains in Dark mottled lithology showing chemical zoning with homogenous Mg-rich core and Fe-rich rim usually accompanying break down product of pyroxyferroite at rim of pyroxene grains[5]. However, composition of pyroxene core in the lithology has more Fe-rich than normal Zagami lithologies. Moreover, minor element compositions (Al, Ti) show compositional jump in mantle of the grain. Therefore, these characteristics may indicate mixing phenomena (magma mixing or crustal assimilation) during volcanic activity on Mars[5]. In this study, we focus on pyroxene compositions in EETA 79001 lithologies A, B and C, and compare with Zagami lithologies.

Sample and method: Thin sections of EETA79001 allocated from the Meteorite Working Group were observed under an optical microscope. Scanning electron microscope observation has conducted using a JEOL JSM-6510LA (Fig.1). Electron microprobe analyses were performed on a JEOL JXA-8900 at the University of Tokyo.

Results: EETA79001 contains several lithologies in a single rock; olivine-phyric shergottite (lithology A), basaltic (lithology B) and glass pods (lithology C). We performed major and minor element analysis for pyroxene grains and compared each other (Fig.2,3). Each lithology shares its compositional signature but have difference in detail.

Lithology A contains pyroxene (~500 μm), maskelynite (~300 μm), olivine (~500 μm) with minor oxides, phosphate, and sulfide minerals. Large melt vein (~500 μm wide) is occurred associate with relict materials which shoes annealed features. Melt vein shows glassy schlieren texture. Pyroxene grains in this lithology show chemical zoning trend; homogenous core with Mg# (=Mg/(Fe+Mg)×100) of 73 and iron contents increase toward the rim (Mg#=55) . Al and Ti contents do not show large variation (Fig.3).

Lithology B contains pyroxene (~500 μm), maskelynite (~300 μm), with minor oxides, phosphate, and sulfide minerals. Few fayalite grains and symplectites are found in this lithology. Small melt pockets are existing. Pyroxene grains in this lithology show chemical zoning trend; homogenous core with Mg# of 70 and iron contents increase toward the rim (Mg#=14). Some part of the rim shows Fe-rich metastable composition. Titanium contents increased at the rim of pyroxene grains.

Lithology C contains mostly glassy materials with fine grained minerals (mostly pyroxene) and relict minerals of olivine (~1 mm) and pyroxene (~500 μm). Boundary between relict materials and melt is unclear and shows corroded texture. Relict materials of coarse-grained olivine and pyroxene show rounded shape. Numerous vesicles are existing in the glass. Relict pyroxene grains in this lithology show relatively homogeneous composition Mg# of 70. Newley crystallized fine grained pyroxene have Fe and Ca rich

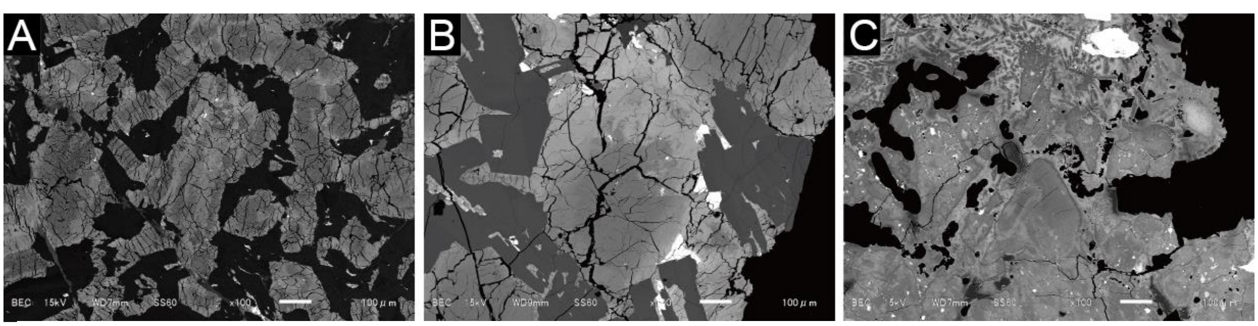

Figure.1. Back scattered electron images of EETA 79001 lithologies. A) Lithology A. B) Lithology B. C) Lithology C. Pyroxene grains in lithologies A and B shows igneous zoning.

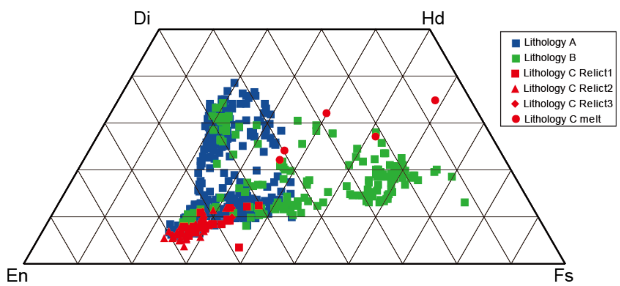

Figure 2. Pyroxene compositions in EETA 79001 lithologies. Lithology A and B shows igneous zoning signature with similar core composition. Lithology C has homogeneous composition in relict pyroxene.

compositions. Al and Ti contents are homogeneous relative to other lithologies.

Discussion: Pyroxene grains in Lithology A and B shows normal igneous zoning. Both lithologies sharing similar core compositions may indicate that both lithologies crystallized in similar condition. However, zoning profile at the rim of grains are different. Lithology B composed more iron rich compositions. Therefore, two lithology cooled in different condition and mixed in late stage. These zoning profiles are similar with other highly evolved shergottites, Zagami normal lithology[6]. Zagami contains highly evolved lithology of dark mottled lithology composed fayalite and pyroxyferroite[5, 7]. Compared with DML, pyroxene grains of EETA79001 lithologies have slightly wider compositional range in Al. Ti contents increase at the rim of pyroxene grains similar with Zagami, however there is not compositional gap.

Lithology C shows unique texture with glassy matrix with relict and newly crystallized minerals of pyroxene. Relict pyroxene has relatively homogenous compositions compared with other lithologies and may reflect annealing at melting event. Al and Ti compositions have similar with lithology A. Geochemical observation of the lithology indicates soil component in this lithology [8, 9]. Origin of lithology C is still matter of debate. Pyroxene compositions of all three lithologies have similar composition (Mg#=70) however, homogeneity of lithology C indicate secondary heating event.

Zagami shows chemical zoning trend and compositional gap in coarse grained (>1mm) pyroxene grains and might reflecting magma mixing or crustal assimilation. On the other hands, EETA79001 Lithology A and B may fractional crystallization products from same magma followed by intense shock metamorphism causing annealing and melting.

Conclusion: We conducted detailed comparison of EETA 79001 lithologies and Zagami. Both shergottite contains several different lithology in a single rock and

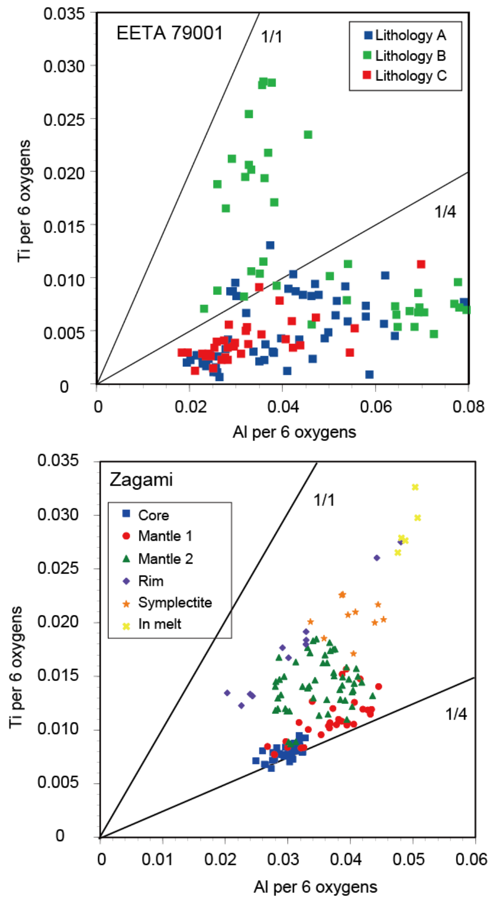

Figure 3. Al and Ti compositions of pyroxene in EETA 79001 lithologies compared with those in Zagami.

may constrains complex magmatism on Mars. Major and minor element compositions of pyroxene grains reflect crystallization process and secondary process include magma mixing and crustal assimilation. EETA 79001 lithology A and B are sharing homogeneous core composition indicating crystallized from similar composition however, Lithology B has more iron rich composition at the rim of the grain. The difference in rim composition indicate different cooling history.

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References:

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