MINERALOGY AND PETROLOGY OF A NEW LUNAR METEORITE EET96008: LUNAR BASALTIC BRECCIA SIMILAR TO Y-793274, QUE94281 AND EET87521. T. Mikouchi, Mineralogical Inst., Graduate School of Science, University of Tokyo, Hongo, Tokyo 113-0033, Japan (E-mail: mikouchi@min.s.u-tokyo.ac.jp).

Introduction: EET96008 is a new basaltic lunar meteorite recovered from Antarctica [1]. It is a fragmental breccia mainly composed of pyroxene, plagioclase and olivine (up to 1.5 mm across) set in a fine-grained dark matrix with a few types of glass. EET87521 (EET87), Y-793274 (Y79) and QUE94281 (QUE94) are known as this type of lunar meteorites (lunar basaltic breccia) [e.g., 2-7]. In this abstract I report a mineralogical and petrological study of the thin section of EET96008 (EET96008,35) and discuss its relationship to EET87, Y79 and QUE94 (EYQ).

Results: EET96 is a basaltic breccia containing mineral fragments of pyroxene, plagioclase and olivine (Fig. 1a, b), lesser amounts of silica, chromite and ilmenite, showing a general similarity to EYQ [2-7]. Mineral fragments in EET96 are irregularly shaped and up to 1.5 mm in size. Lithic clasts consisting of more than two phases are not so abundant as EYQ. The matrix is very heterogeneous and dark in color. Both vesicular brownish glass and dark brown agglutinate glass were observed (Fig. 1b).

Pyroxene in EET96 has a wide compositional range in Mg, Fe and Ca (Fig. 2), but each fragment has a moderately narrow composition. Pyroxenes are pigeonite and ferroan augite. Both of them contain exsolution lamellae of pyroxene usually reaching 0.5-1 µm wide, respectively (Fig. 1c). The coarseness of lamellae resembles those of EYQ [e.g., 4,5,8] and suggests slow cooling, in contrast to typical mare basalts. To assess the mare origin of pyroxene fragments in EET96, atomic Fe/(Fe+Mg) (*Fe#*) and Ti/(Ti+Cr) (*Ti#*) of pyroxene were also plotted on Fig. 3a. They are located in the areas of very low-Ti (VLT) and low-Ti mare basalts in general, with wide ranges for both. Similar variation is observed for EYQ pyroxenes [e.g., 4,6,8]. Ti-rich and Fe-poor pyroxene plotted above the general trends of VLT and low-Ti basalts is probably derived from highland and observed for both EET96 and Y79 (Fig. 3a). One of the most abundant lithic fragments consists of fayalite, hedenbergite and silica, suggesting slow cooling and strong differentiation (Fig. 1d). Mineral sizes range from 10 to a few hundreds µm. Similar assemblage is also reported from Y79 and QUE94 [2,5]. Plagioclase ranges from An_{95} to An_{63}, but mostly clusters around An_{90-95} (Fig. 2). There is little compositional difference between large plagioclase fragments and small clasts in the matrix. Olivine shows a bimodal compositional range of Fo_{65-52} and Fo_{38-30} except for fayalite (Fo_{16-5}) (Fig. 1d). The same compositional range is reported from olivine in Y79 [3,4]. Spinel in EET96 is Fe-rich (58 wt% FeO) and has 26 wt% TiO_2 and 11 wt% Cr_2O_3. Ilmenite contains 0.3-0.6 wt% MgO. These opaque compositions well accord with those in EYQ [8].

There are two dominant types of glass in EET96, vesicular brownish glass and dark brown agglutinate glass. However, they are not so abundant as QUE94 [4-7]. Spherical glass is rare in EET96. It is difficult to distinguish between fusion crust and vesicular glass in the section studied, because it contains only small amounts of glasses and fusion crusts. Nevertheless, its complex texture suggests a similarity to QUE94 [4-7]. Vesicular glass in EET96 has a narrow compositional range whereas aggutinate glass is fairly heterogeneous. Fig. 3b shows Fe and Al variations of vesicular glasses and fusion crusts in QUE94 and EET96 (QUE94: colorless vesicular glass, EET96: brownish vesicular glass). Both are plotted around the same line, suggesting mixing of the same two components. The fusion crust of EET96 contains more Fe and less Al in contrast to QUE94, but probably reflects a local mixed clast assemblage.

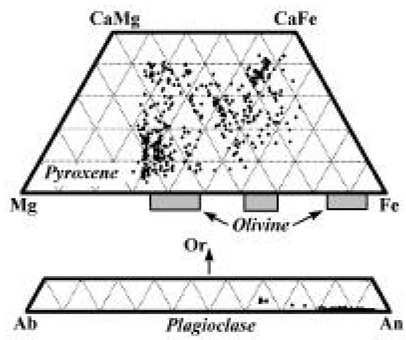
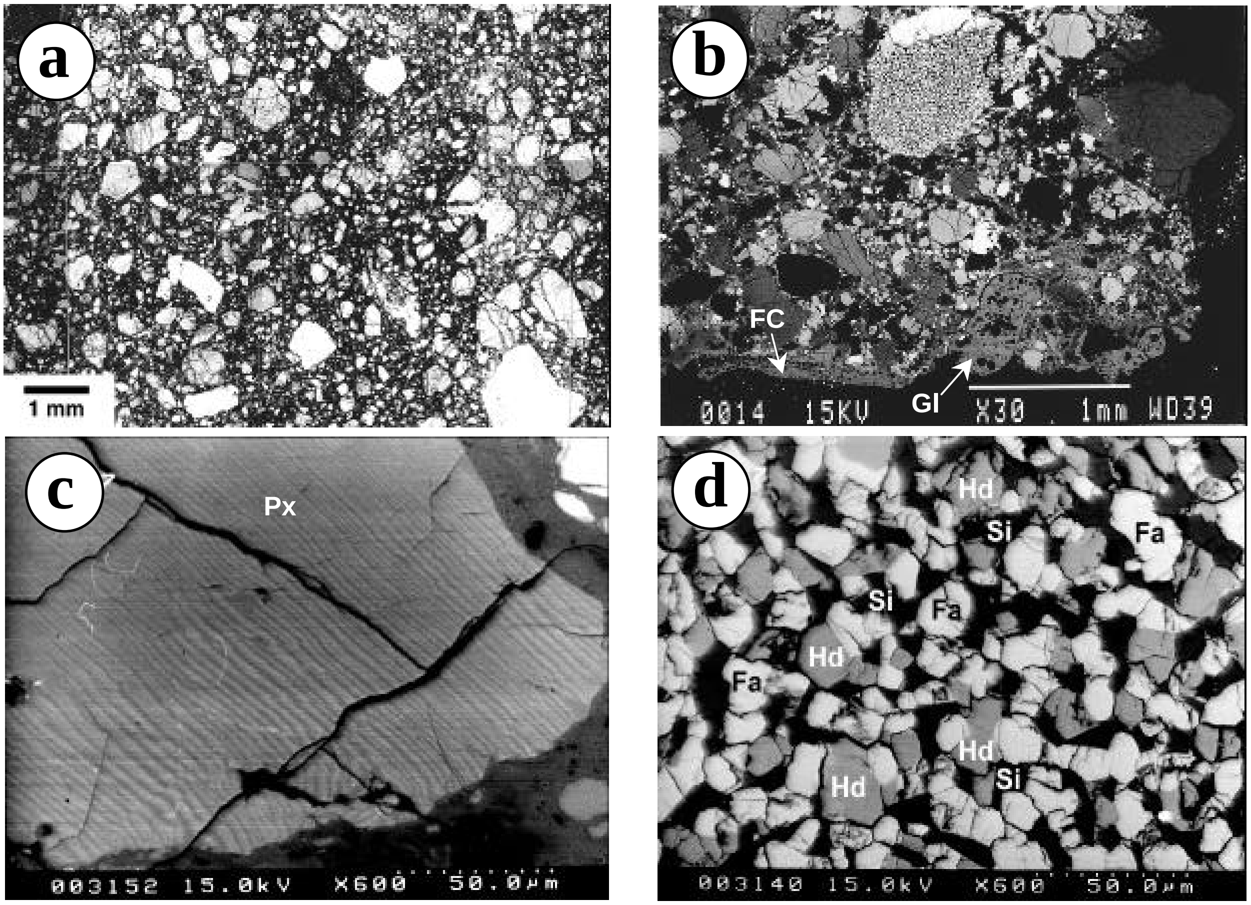


Fig. 2. Pyroxene quadrilateral, forsterite-fayalite content of olivine, and feldspar compositions of EET96008.

Discussion and Conclusion: EET96 shows remarkable similarities to EYQ in many respects (petrography, mineral compositions of pyroxene, plagioclase and olivine, presence of coarse pyroxene exsolution, variation of *Fe#* and *Ti#* in pyroxene, opaque composition, glass and fusion crust compositions). Especially, EET96 shows a closest match to Y79. Their mineral compositions almost accord to each other in both major and minor elements. However, the presence of vesicular glass indicates a closer relationship to QUE94. Thus, EET96 is a fragmental breccia containing both mare and highland materials, but mare samples of VLT and low-Ti basalts are dominated. It is likely that EET96 originated from the same source crater on the Moon together with Y79, QUE94, and probably EET87. Therefore, discovery of EET96 has further tightened the relationship of this type of lunar meteorites as has been proposed [e.g., 8].

References: [1] McBride K. and Mason B. (1998) *Antarct. Meteorite Newsl., 21 (1)*, 12. [2] Takeda H. et al. (1991) *Proc. NIPR Symp. on Antarct. Meteorites, 4,* 3-11. [3] Yanai K. and Kojima H. (1991) *Proc. NIPR Symp. on Antarct. Meteorites, 4,* 70-90. [4] Arai T. et al. (1996) *LPS XXVII,* 33-34. [5] Joliff B. L. et al. (1996) *LPS XXVII,* 615-616. [6] Kring D. A. et al. (1996) *LPS XXVII,* 707-708. [7] Lindstrom M. M. (1996) *LPS XXVII,* 761-762. [8] Arai T. et al. (1996) *Meteoritics & Planet. Sci., 31,* 877-892.



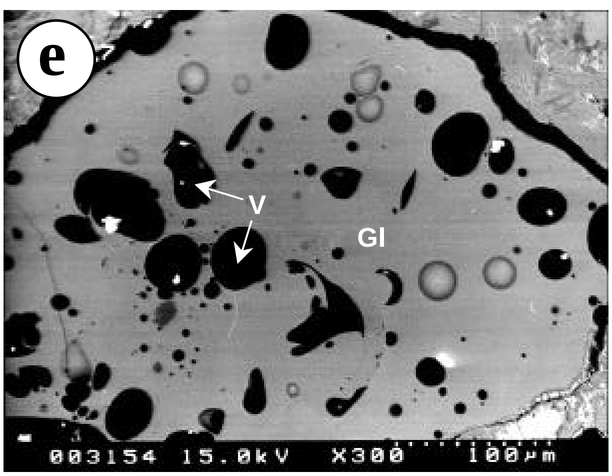


Fig. 1. (a) Optical photomicrograph of EET96008,35. Many mineral fragments (mainly pyroxene and plagioclase) are scattered within a glassy matrix. (b) Backscattered electron image (BEI) of EET96008,35. FC: fusion crust. Gl: brownish vesicular glass. (c) BEI of a large pyroxene grain reaching 0.5 mm. Coarse exsolution lamellae of up to 2 mm wide are visible. Px: pyroxene. (d) BEI of a large clast (~1 mm across) consisting of fine-grained fayalite, hedenbergite and silica. It is located near top center of (b). Fa: fayalite. Hd: hedenbergite. Si: silica. (e) BEI of brownish vesicular glass. It is located near bottom center of (b) (indicated by arrow). Gl: glass. V: vesicle.

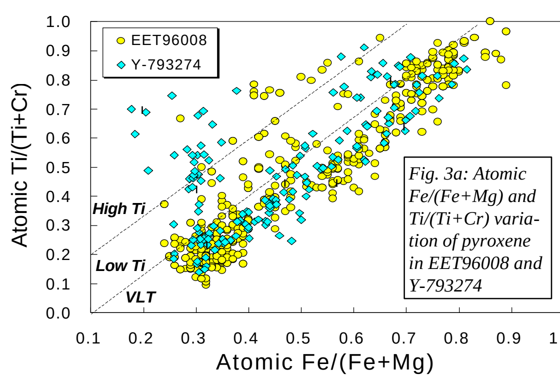


Fig. 3a: Atomic Fe/(Fe+Mg) and Ti/(Ti+Cr) variation of pyroxene in EET96008 and Y-793274

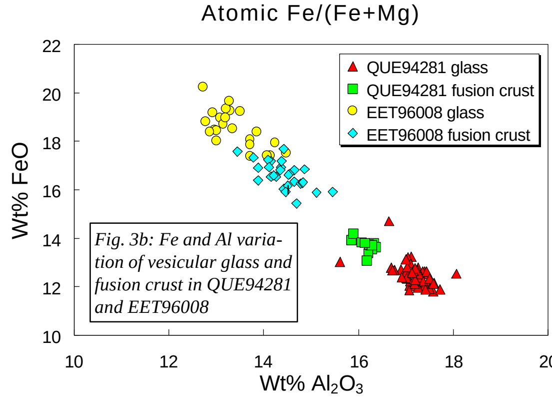


Fig. 3b: Fe and Al variation of vesicular glass and fusion crust in QUE94281 and EET96008