# COOLING RATE OF OLIVINE MEGACRYST IN THE YAMATO 980459 OLIVINE PHYRIC SHERGOTTITE.

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**Introduction:** Yamato 980459 (Y98) is a new olivine-phyric shergottite showing several different mineralogical features from other samples in this group. Y98 is a glassy rock showing a porphyritic texture composed of olivine megacrysts and medium-grained pyroxene with abundant mesostasis. In contrast to all other martian meteorites, this meteorite contains no plagioclase. Olivine megacrysts ($Fo_{85-79}$) are euhedral to subhedral and up to 2 mm in size. Olivine (tens to hundreds of µm; $Fo_{79-40}$) also exists in the groundmass coexisted with zoned pyroxene ($En_{81}Fs_{17}Wo_2$ to $En_{22}Fs_{43}Wo_{35}$). The mesostasis is glassy, but contains dendritic olivine and pyroxene with other minor minerals [1-2].

**Previous work:** As a previous work, we performed a crystallization experiment and phase calculation with the MELTS program [3]. We found that olivine megacryst in Y98 is possibly a phenocryst because the core composition of olivine megacryst is in equilibrium with the Y98 bulk composition and this was confirmed by the crystallization experiment. These results indicate that the Y98 bulk composition represents a parent melt composition. Furthermore, the core composition of pyroxene is in equilibrium with the rim composition of olivine megacryst ($Fo_{79}$) suggesting that the groundmass pyroxene started crystallizing when the olivine composition reached $Fo_{79}$, which would mark the crystallization of the groundmass olivine. The glassy mesostasis seems to have been formed under a significant undercooling condition suppressing the plagioclase crystallization.

**Cooling rate of olivine megacryst:** In this study, we calculated the cooling rate of olivine megacryst in Y98 considering both fractional crystallization and diffusional modification with a method similar to [4]. Cooling is assumed to be linear from 1460 $^oC$ (liquidus of olivine megacryst as estimated by the calculation and experiment) down to 1200 $^oC$ (just above the liquidus of plagioclase). We also assumed that olivine crystallization ended around 1360 $^oC$ that is the pyroxene liquidus temperature estimated by the calculation. The oxygen fugacity under which olivine crystallized was supposed to be IW+1 as estimated by [5]. According to the calculation result, the best-fit cooling rate of olivine megacryst in Y98 is about 1 $^oC$/hr. This cooling rate suggests that Y98 crystallized at very shallow depth near the martian surface. It is an important issue whether two-stage cooling history (quenching of the magma at some late stage) is required to produce a porphyritic texture with glassy groundmass as observed in Y98. It is not clear whether 1 $^oC$/hr linear cooling can suppress the plagioclase crystallization although our previous experimental work of QUE94201 indicated that the linear cooling at 0.7 $^oC$/hr could produce a porphyritic texture with glassy mesostasis [6]. We are planning to perform a 1 $^oC$/hr cooling experiment of Y98 to verify that this cooling rate can reproduce the Y98 texture.

**References:** [1] Mikouchi T. et al. 2003. *NIPR Symp.,* 82–83. [2] McKay G. et al. 2003. *NIPR Symp.,* 76-77. [3] Koizumi E. et al. 2004. Abstract #1494. 35th Lunar & Planetary Science Conference. [4] Miyamoto M. 1999. *Meteoritcs & Planetary Science* 34:A82. [5] McKay G. et al. 2004. Abstract #2154. 35th Lunar & Planetary Science Conference. [6] Koizumi E. et al. 2003. *Geochimica et Cosmochimica Acta,* 67:A227.