IS DIAPLECTIC GLASS A GLASS?

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Introduction: Plagioclase feldspar is the most abundant components of igneous rocks found in the crust of Earth and lunar highland rocks. They can also be seen in lunar and Martian meteorites, and detected on the surfaces of Mars, Venus and Mercury. Knowledge of how plagioclases response to the variations of pressure and temperature is important for revealing the pressure-temperature history of natural impact events on planetary bodies as well as highly shock meteorites. Among all the features observed in shocked plagioclase, diaplectic glass is the most diagnostic evidence of strongly shock stage. Shock-recovery experiments were used to study the formation of diaplectic glass since 1960s [1-6]. However, temperature from these shock experiments were not easily calculated and their timescales were much shorter than those in natural events. Furthermore, while there have been some recent static studies to demonstrate the amorphization of plagioclase [7], the high-pressure and high-temperature behavior of intermediate plagioclase at pressure above 25 GPa is still poorly understood, and phase diagram reminds unclear.

Methods: In this study, we conducted high-pressure and high-temperature static experiments on natural intermediate plagioclase -- labradorite (An51), using *in situ* synchrotron X-ray diffraction and laser heating diamond-anvil cell at beamline 13ID-D, GSECARS sector of the Advanced Photon Source, Chicago.

Results: After many rounds of experiments in the past five years, we were able to construct the phase diagram of intermediate plagioclase with pressure ranging up to 65 GPa and temperature up to 2500K. Together with the phase boundary of amorphization drawn by Kubo et al. (2010) and Hugoniot curve data reported by Ahrens et al. (1969), we were able to constrain the pressure-temperature range for the formation of diaplectic glass. Comparing with the pressure range proposed by Stöffler et al. (2018), our results suggest that diaplectic glass can form in a much wider range, as shown in Figure 1.

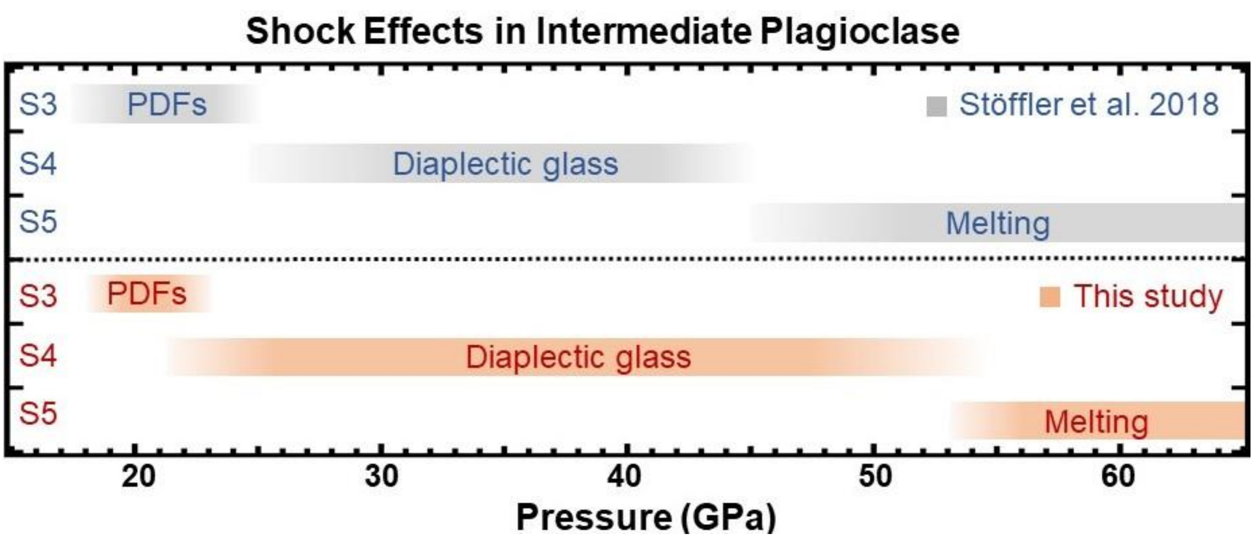

Figure 1. Shock effects in intermediate plagioclase from shock stage S3, S4, and S5 and their pressure-temperature range of formation proposed by Stöffler et al. (2018) and this study, PDFs=planar deformation features.

References:

[1] Ostertag, R. (1983) *Journal of Geophysical Research: Solid Earth* 88: B364-B376. [2] Stöffler D., Ostertag R., Jammes C., et al. (1986) Geochimica et Cosmochimica Acta 50:889-903. [3] Stöffler D., Keil K., and Scott E. R. D. (1991) Geochimica et Cos-mochimica Acta 55:3845-3867. [4] Stöffler D., Hamann C., and Metzler K. (2018) *Meteoritics & Planetary Science* 53:5- 49. 64. [5] Fritz J., Assis Fernandes V., Greshake A., Holzwarth A., and Böttger U. (2019) *Meteoritics & Planetary Science* 54(7): 1533-1547. [6] Jaret S. J., Johnson J. R., Sims M., et al. (2018) *Journal of Geophysical Research: Planets* 123:1701- 1722. [7] Kubo T., Kimura M., Kato T., Nishi M., Tominaga A., Kikegawa T., and Funakoshi K. 2010. *Nature Geoscience* 3:41-45. [8] [8] Ahrens T. J., Petersen C. F., and Rosenberg J. T. (1969) *Journal of Geophysical Research* 74(10):2727-2746.