Effect of melt viscosity on nuclear waste glass foaming

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Understanding the dynamics of bubble nucleation, growth, and coalescence in glass melts, as well as melt foaming and collapse, is important for both geology and glass technology. In magmas, gas solubility becomes oversaturated as a result of decompression [1]. In molten manmade glasses, gases evolve when sulfate decomposition and redox reactions are triggered by rising temperature. Whereas gas evolution in magmas can lead to violent explosion [1], in commercial and nuclear waste glasses, bubbles can accumulate creating foam that insulates the melt from incoming heat and thus hinders the melting process. The main foam stabilizer in silicate glasses is the melt viscosity. We investigated the effect of viscosity on foam growth and collapse in a series of simulated nuclear waste glasses with viscosities ranging from 0.5 to 9.5 Pa s at 1150°C. Bubbles form from gas-evolving reactions as soon as the glass-forming melt becomes connected [2]. To study the effect of viscosity on foaming during nuclear waste glass melting, we monitored the volume expansion of glass batch pellets in response to heating at 10 K min^{-1}. The volume was computed using numerical integration from the profile area of pellet images [3]. Foam volume and foaming temperature substabntially increased within a relaively narrow range of viscosities (Fig. 1).

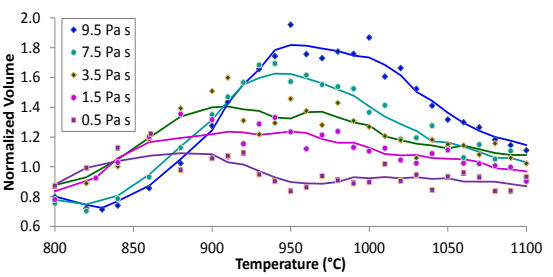

Fig. 1. Normalized volume vs. temperature

[1] C. Martel & G. GiadaIacono-Marziano (2015) *Earth Planet. Sci. Letters* **412** 173-185. [2] S. H. Henager *et al.* (2011) *J. Non-Cryst. Solids* **357** 829-835. [3] Z. Hilliard & P. Hrma (2016) *J. Amer. Ceram. Soc.* **99** 98-105.