The Formation and Structure of a Dense Octahedral Glass

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The structure of tetrahedral-oxide glasses at ambient pressure is well studied [1]. However, at the pressures of the Earth's mantle these glasses, and by extension liquids, are known to undergo a transition to a dense, octahedrally-coordinated structure [2]. However, the continuous nature of this transformation has been debated, and the concurrent changes in intermediate-range order are unknown. We have studied the structure of vitreous germania, an archetypal tetrahedral glass, using in-situ x-ray and neutron diffraction with increasing pressure up to 15 GPa. Below 5 GPa, additional atoms encroaching on the first tetrahedral shell are seen to be a precursor to coordination change. Between 6 and 10 GPa we observe structures with a constant average coordination of nearly five. At 15 GPa, the structure of a fully octahedral glass has been measured. It is characterised by a mixture of both edge-shared and corner-shared octahedra. The dense octahedral-glass structure may provide an insight into the behaviour of viscous melts in the mantle.

References

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