

Experimental study on the conditions of inclusions capturing during diamond growth in the upper mantle

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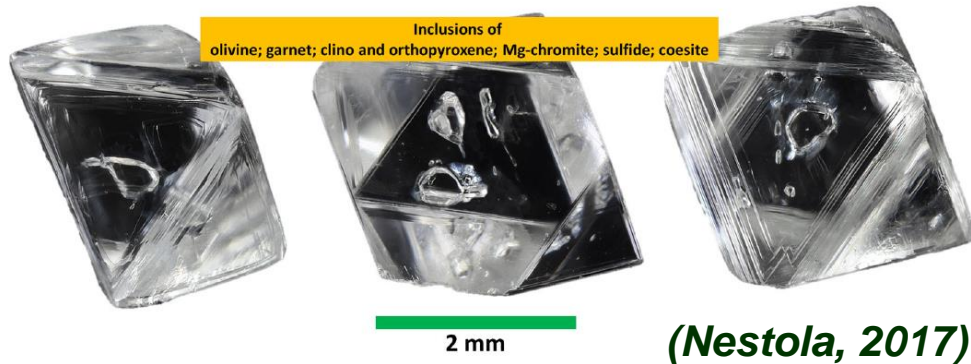


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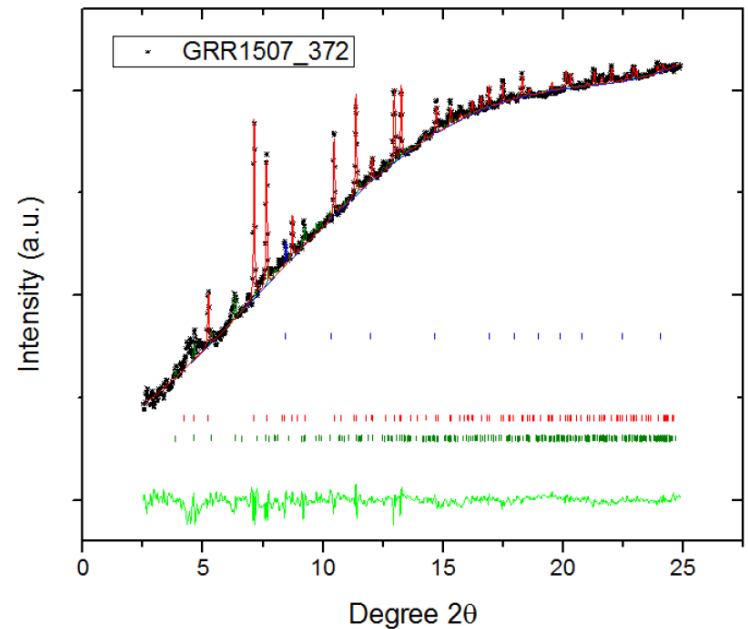
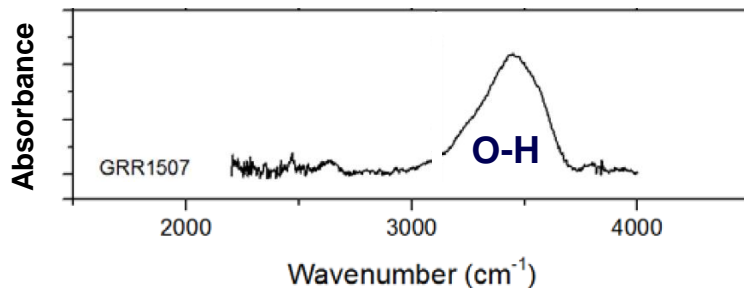
Modelling the deep Earth



Inclusions in natural diamonds provide unique information about deep-seated mantle minerals and fluids.

Ice-VII inclusions in diamonds: Evidence for aqueous fluid in Earth's deep mantle

O. Tschauner,^{1*} S. Huang,¹ E. Greenberg,² V. B. Prakapenka,² C. Ma,³ G. R. Rossman,³ A. H. Shen,⁴ D. Zhang,^{2,5} M. Newville,² A. Lanziloti,² K. Tait⁶



Diffraction pattern of Ilm+Ice-VII inclusion

Experimental methods:

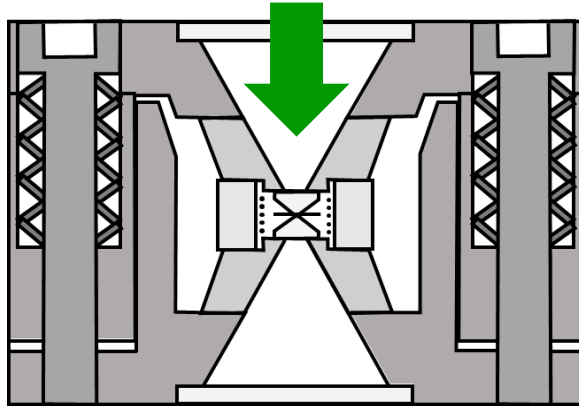
- *In situ* analysis using diamond anvil cell (DAC) technique
- High-pressure synthesis in a Bridgman-type apparatus



Studied system: Ilmenite + Olivine + H₂O (14-20 mol.%)

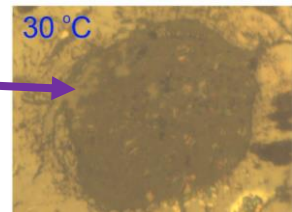
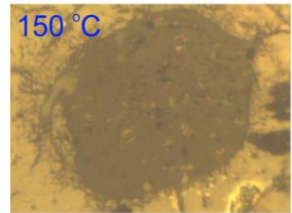
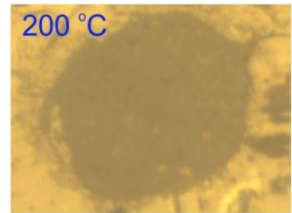
In situ observations

Optical access

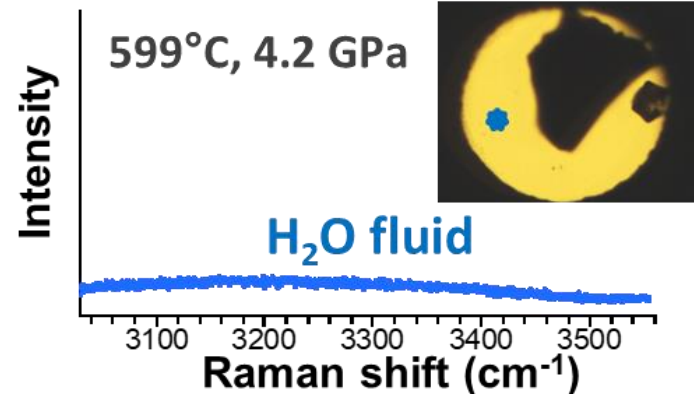
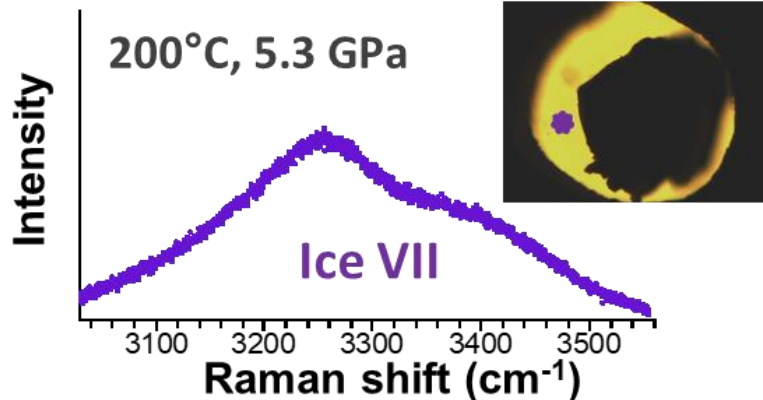


Externally heated DAC

Monitoring the state of H₂O phases through transparent diamond anvils

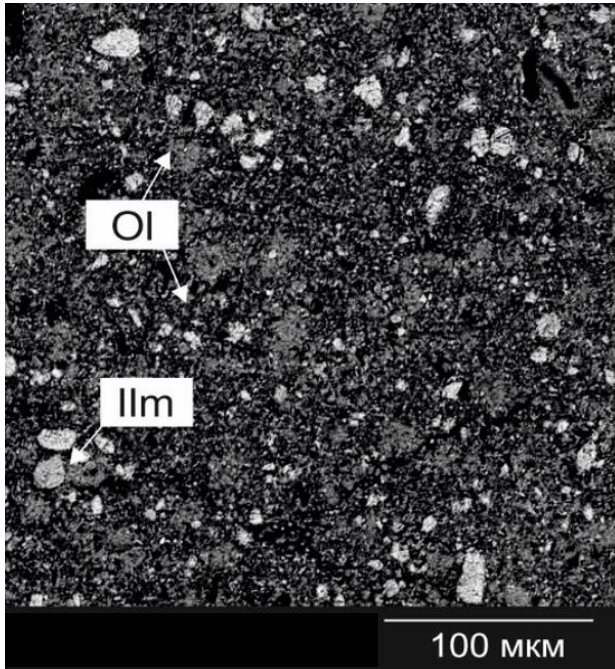


Raman analysis

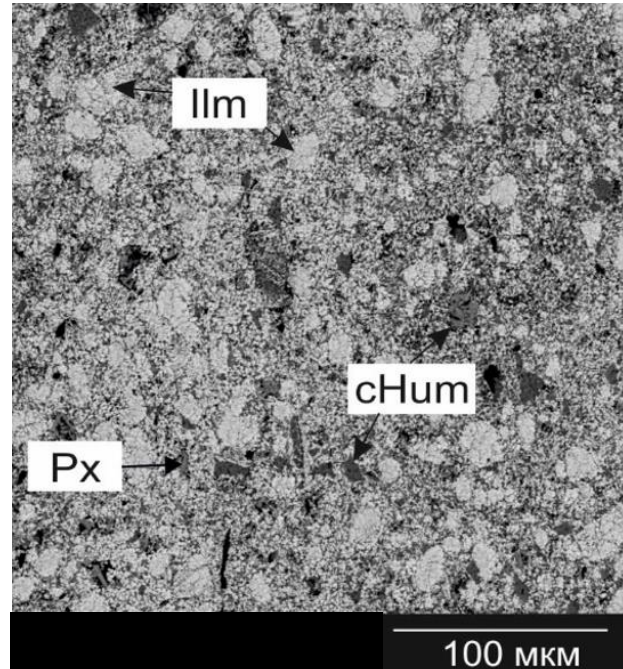


Phase relations at 1200°C, 6 GPa

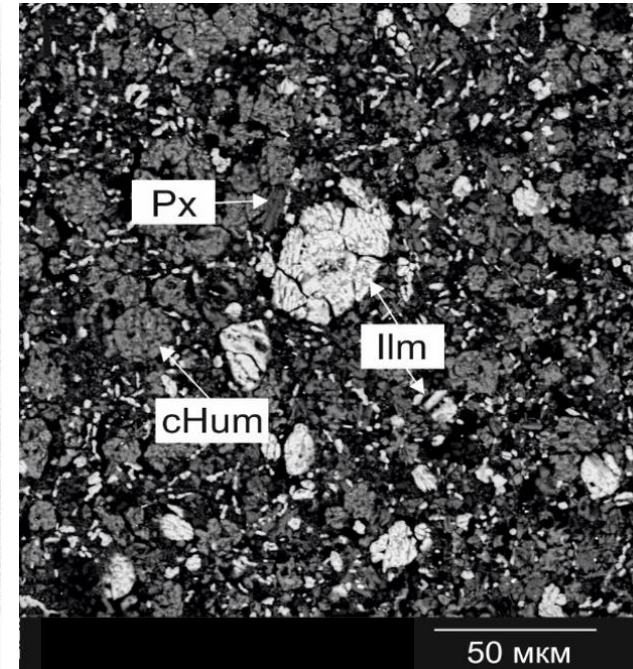
Ilm₇₅Ol₂₅ + H₂O



Ilm₅₀Ol₅₀ + H₂O



Ilm₂₅Ol₇₅ + H₂O



Run products:

Ilmenite + Olivine

**Ilmenite + Pyroxene
+ Humite**

**Ilmenite + Pyroxene
+ Humite**

Comparison with natural associations

Ice VII inclusions in diamonds and associated phases:
(*Tschauner et al., 2018*)

Specimen	Ice-VII volume (Å ³)	<i>P</i> (GPa)	<i>P</i> _{cor} (GPa)	Coexisting phases	Other phases
GRR1507	33.689(8)	6(1)	7(2)	Ilmenite† 85%	Olivine (Fo94-97),‡ calcite, sellaite
GRR1507	32.40(1)	7.9(1.4)	9(2)	Ilmenite† 81%	

Experiment:

Association of Ilmenite and Olivine in the presence of hydrous fluid
in the systems with Ilmenite : Olivine mole ratio $\geq 75 : 25$.

At lower ratio, a reaction with the formation of Pyroxene and Humite
phases was observed.

Summary

- A combination of high-pressure techniques was applied for the investigation of mineral associations and H₂O phases, captured as inclusions in diamonds, in the pressure range from 4 to 8 GPa and temperatures from 500°C to 1250°C.
- Experimental results revealed possible reactions of ilmenite, olivine and hydrous fluid with the formation of new phases (pyroxene and humite) in the diamond stability field.
- Obtained data can be used for reconstruction of diamond growth media in the lithosphere.