

Metal-Silicate Differentiation in Early Accreted Bodies: a Joint Experimental and Theoretical Study

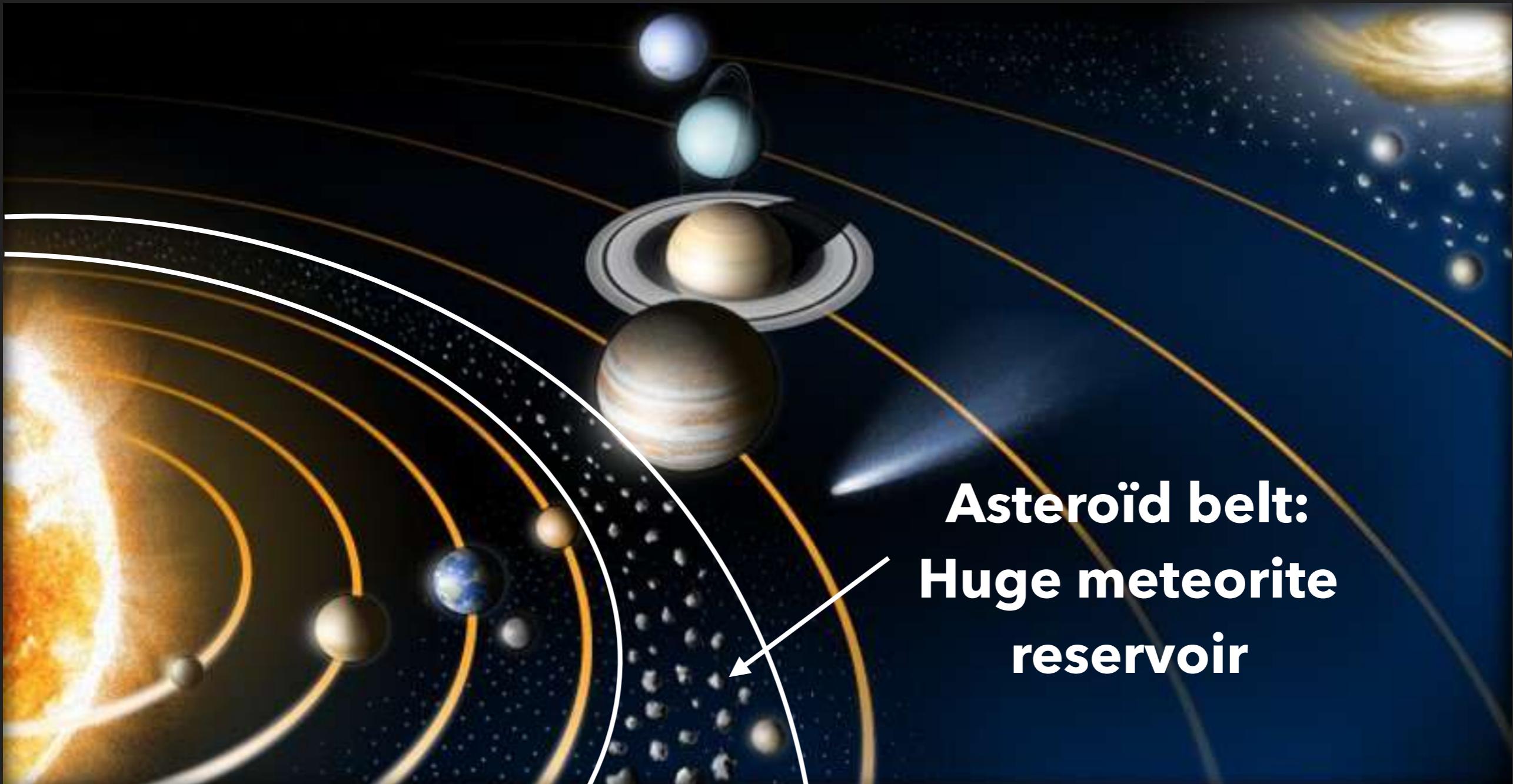
A. Néri (DIP Team)

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J. Guignard
M. J. Toplis
M. Monnereau
G. Quitté

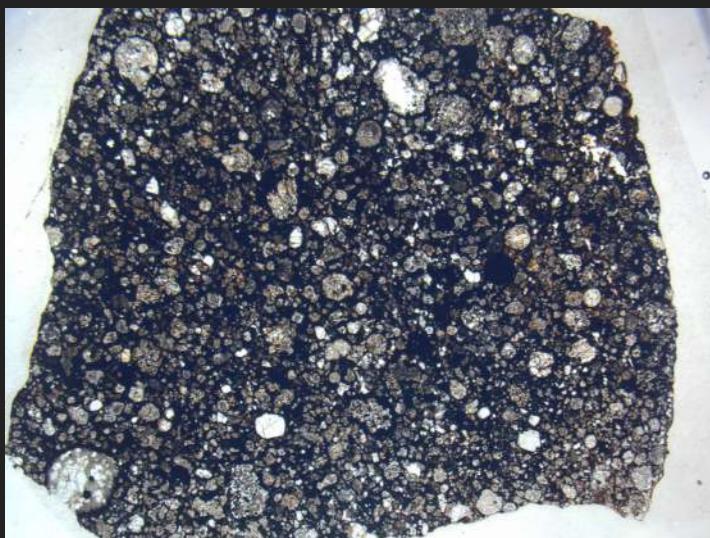


HOW TO STUDY PLANET FORMATION IN OUR SOLAR SYSTEM ?

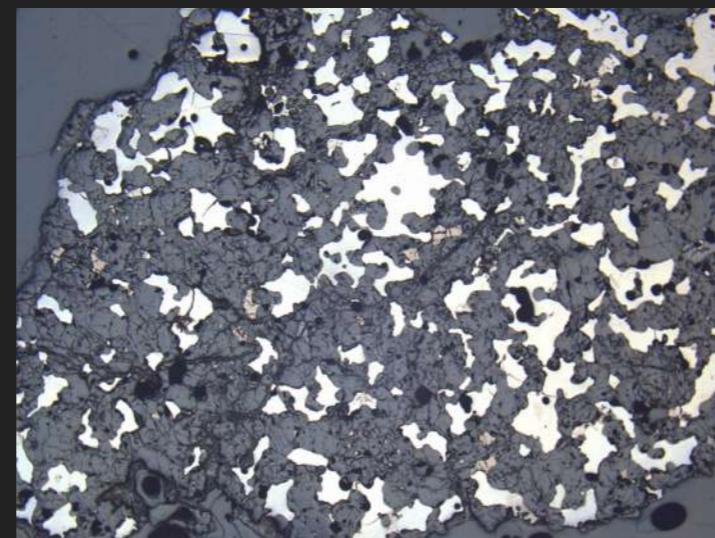
METEORITES = PRIMITIVE « CHUNKS » OF PLANETESIMALS



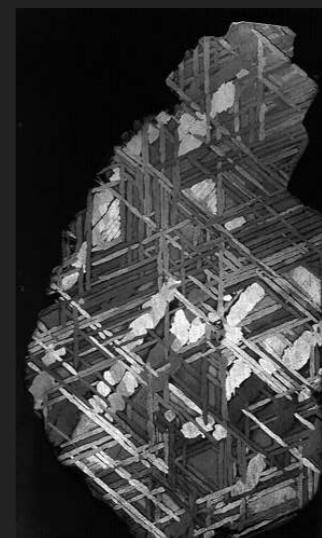
METEORITES: PRIMITIVE, COMPLEX AND DIVERSE OBJECTS



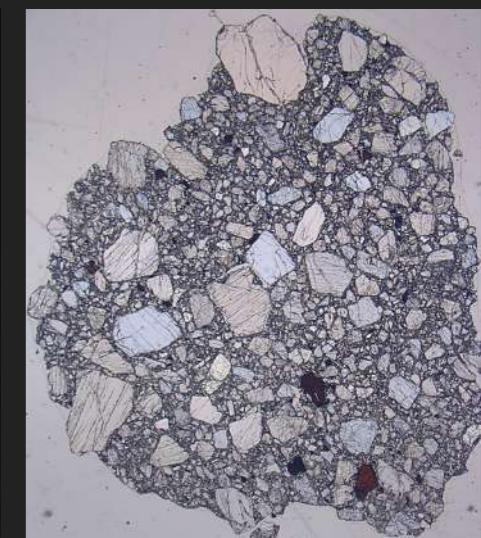
Rock-metal mixture



Rock-metal mixture

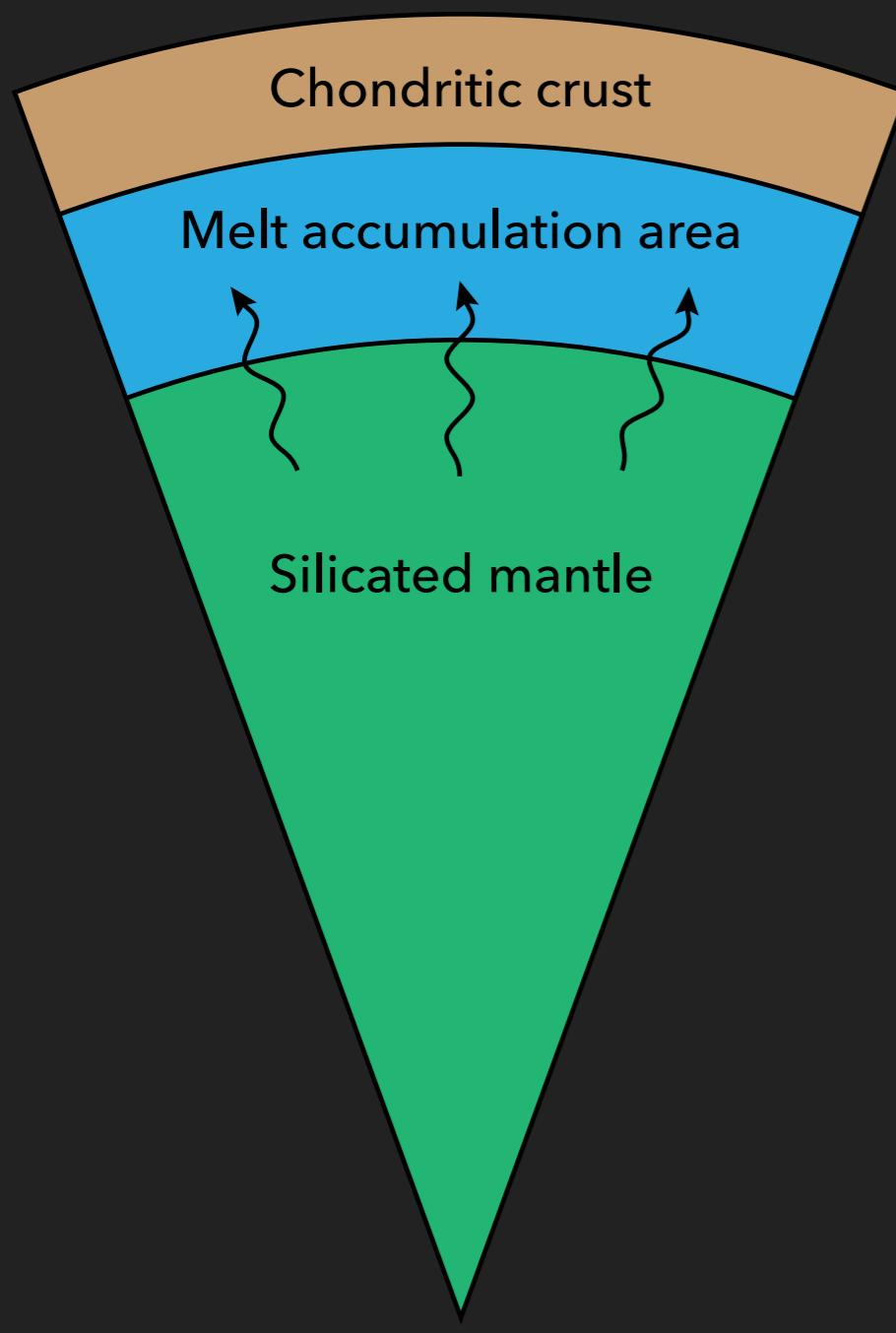


Metal

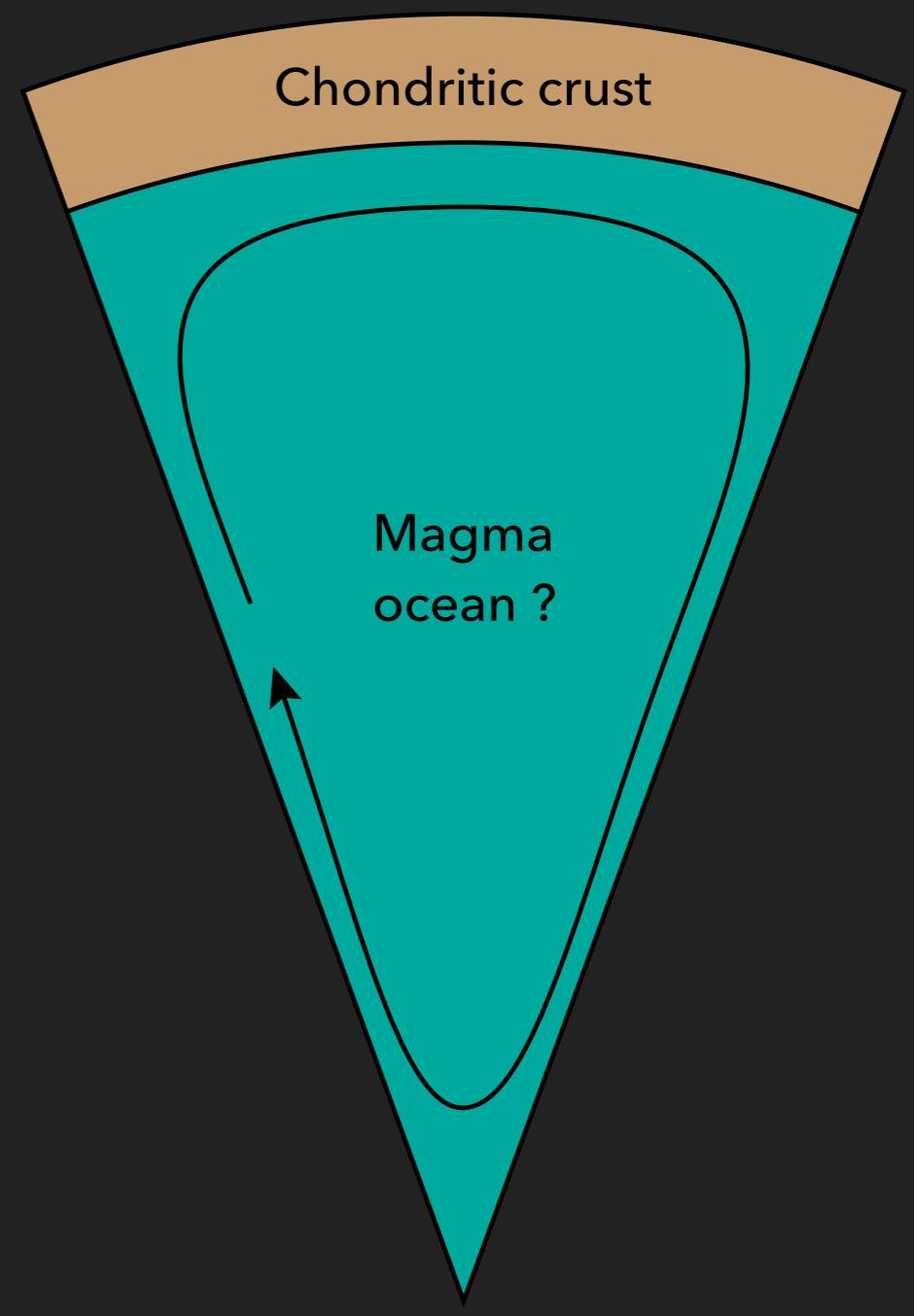


Rock

TWO MAIN EVOLUTIONARY SCHEMES

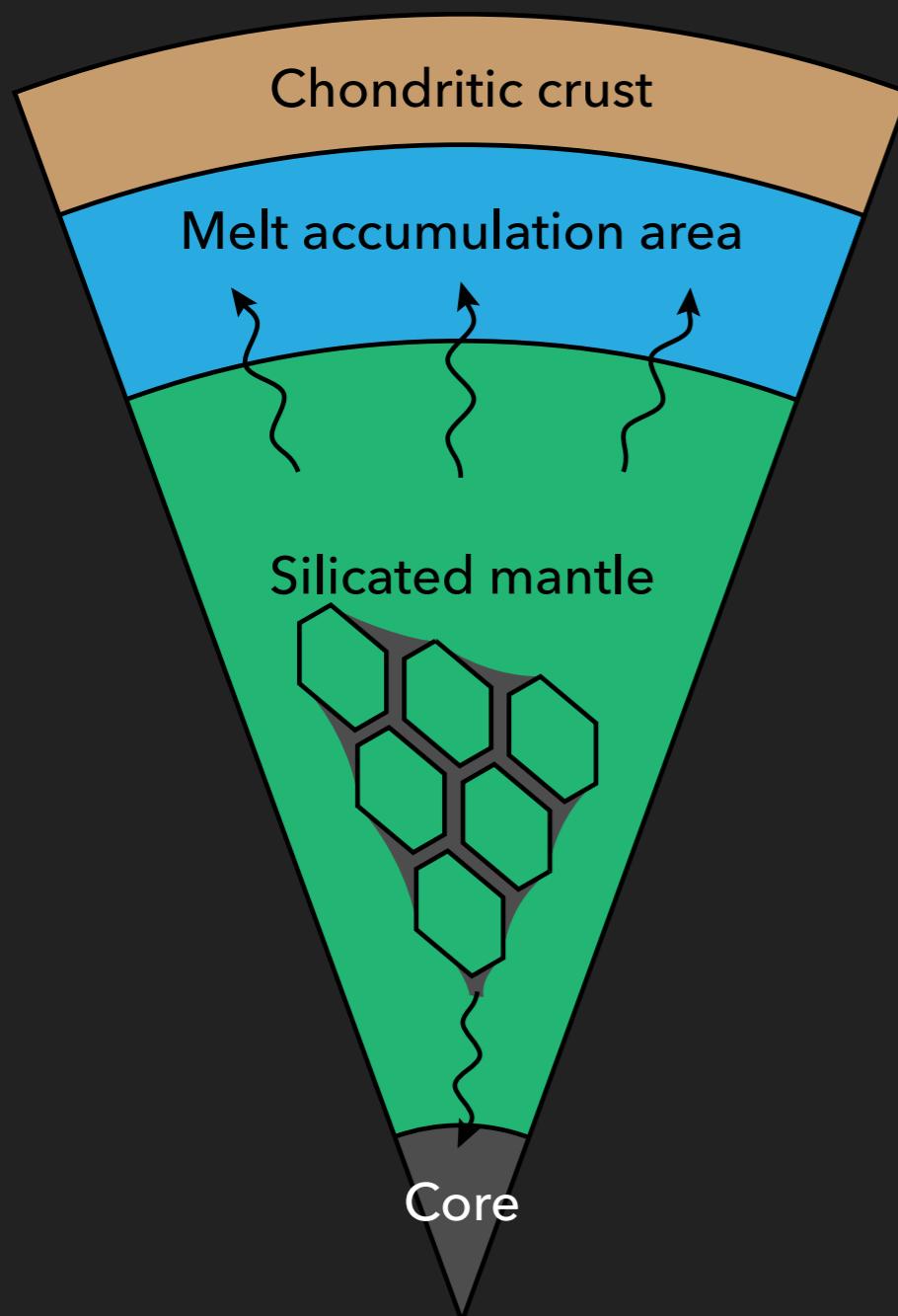


Extraction of silicate melt
Fractionate melting



Immobile silicate melt
Equilibrium melting

TWO MAIN EVOLUTIONARY SCHEMES

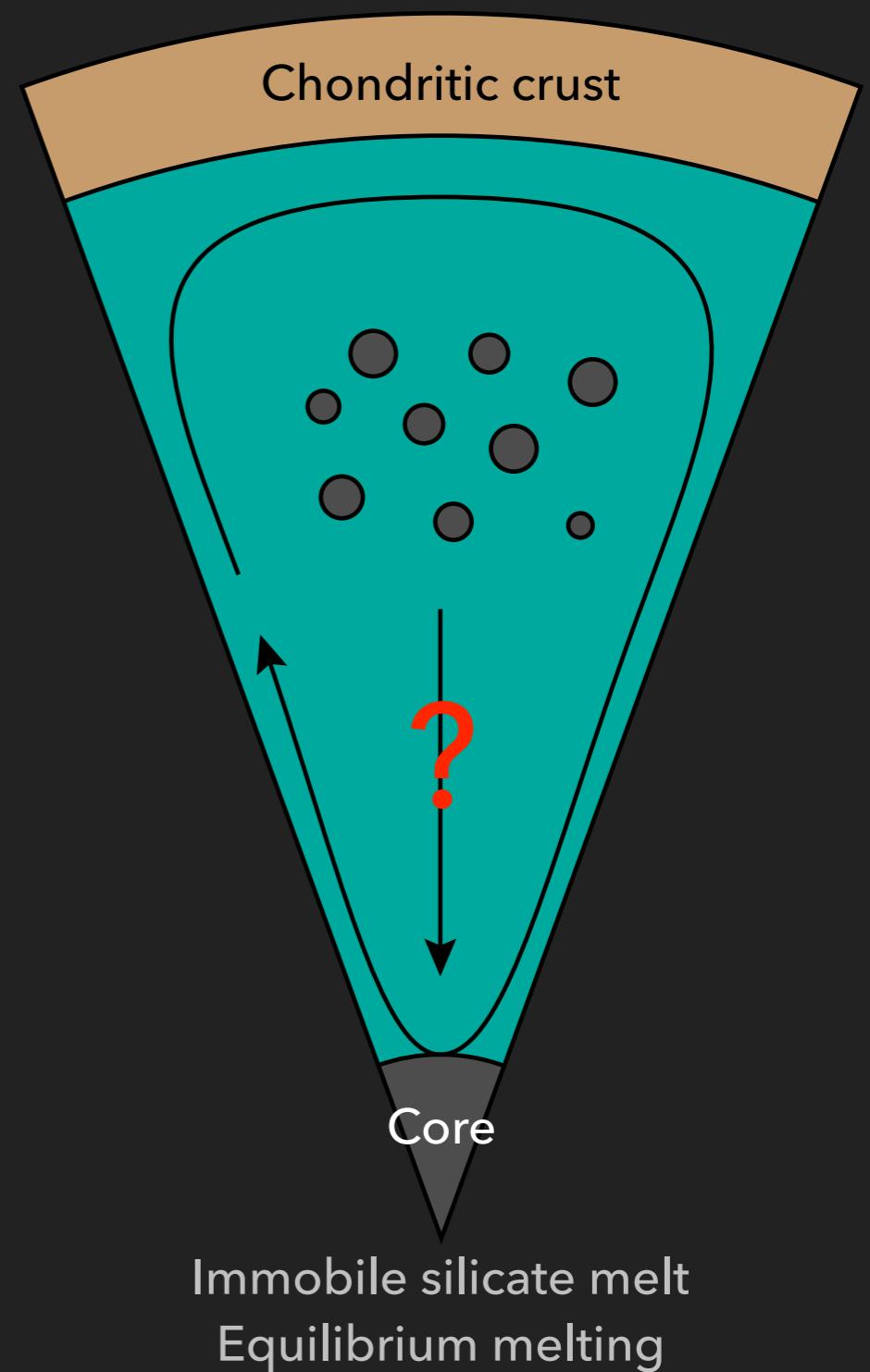
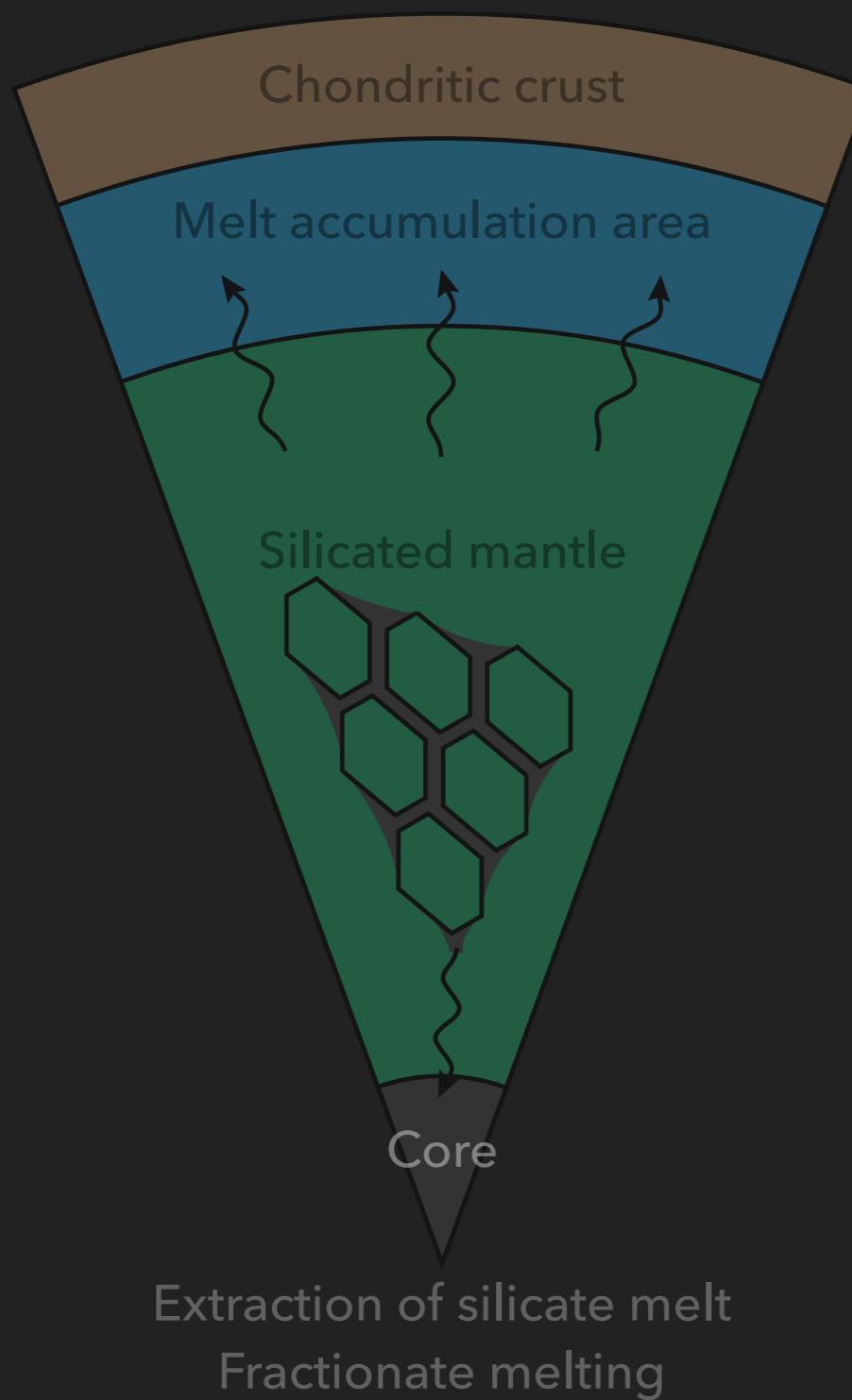


Extraction of silicate melt
Fractionate melting



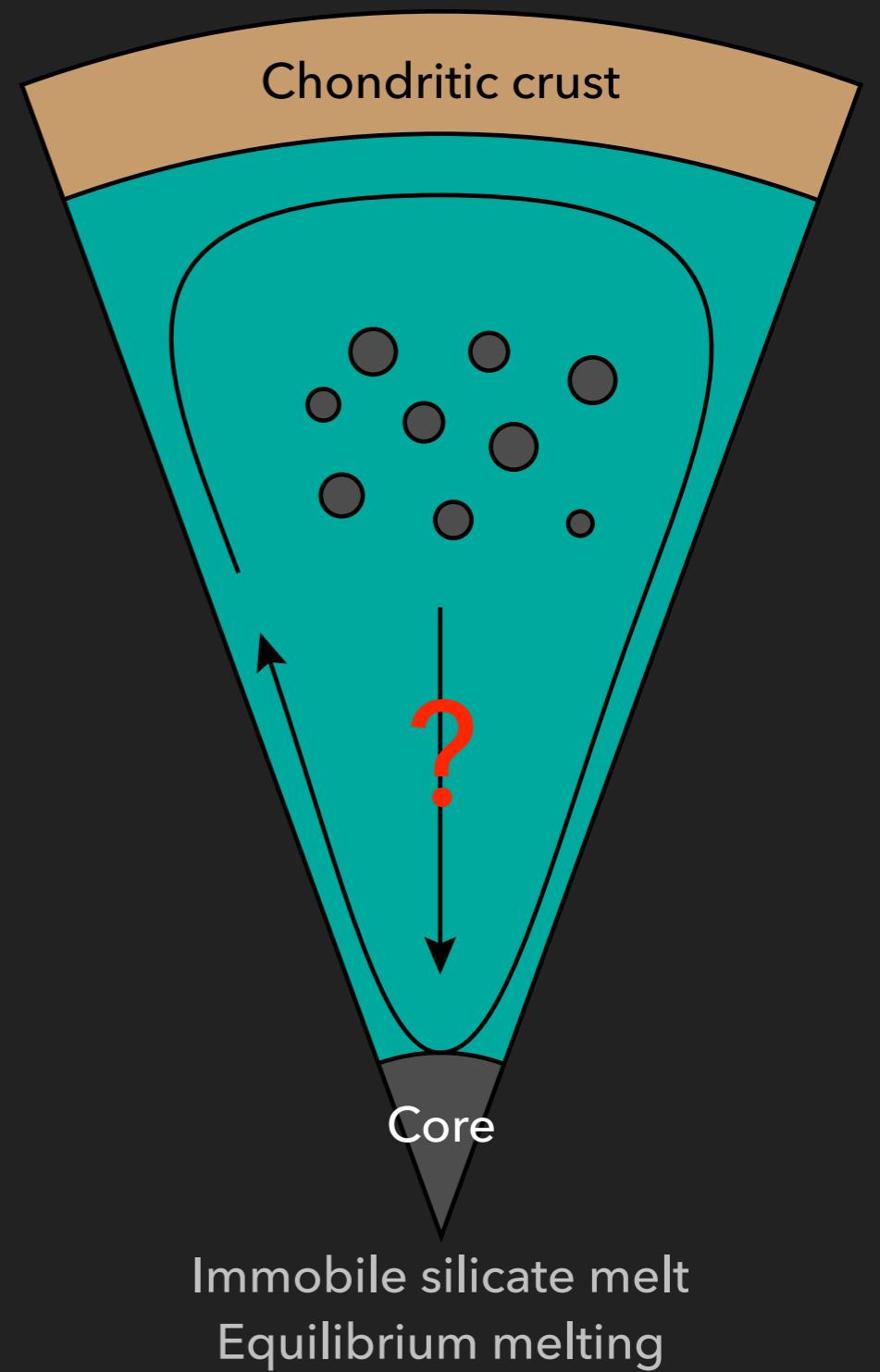
Immobile silicate melt
Equilibrium melting

TWO MAIN EVOLUTIONARY SCHEMES



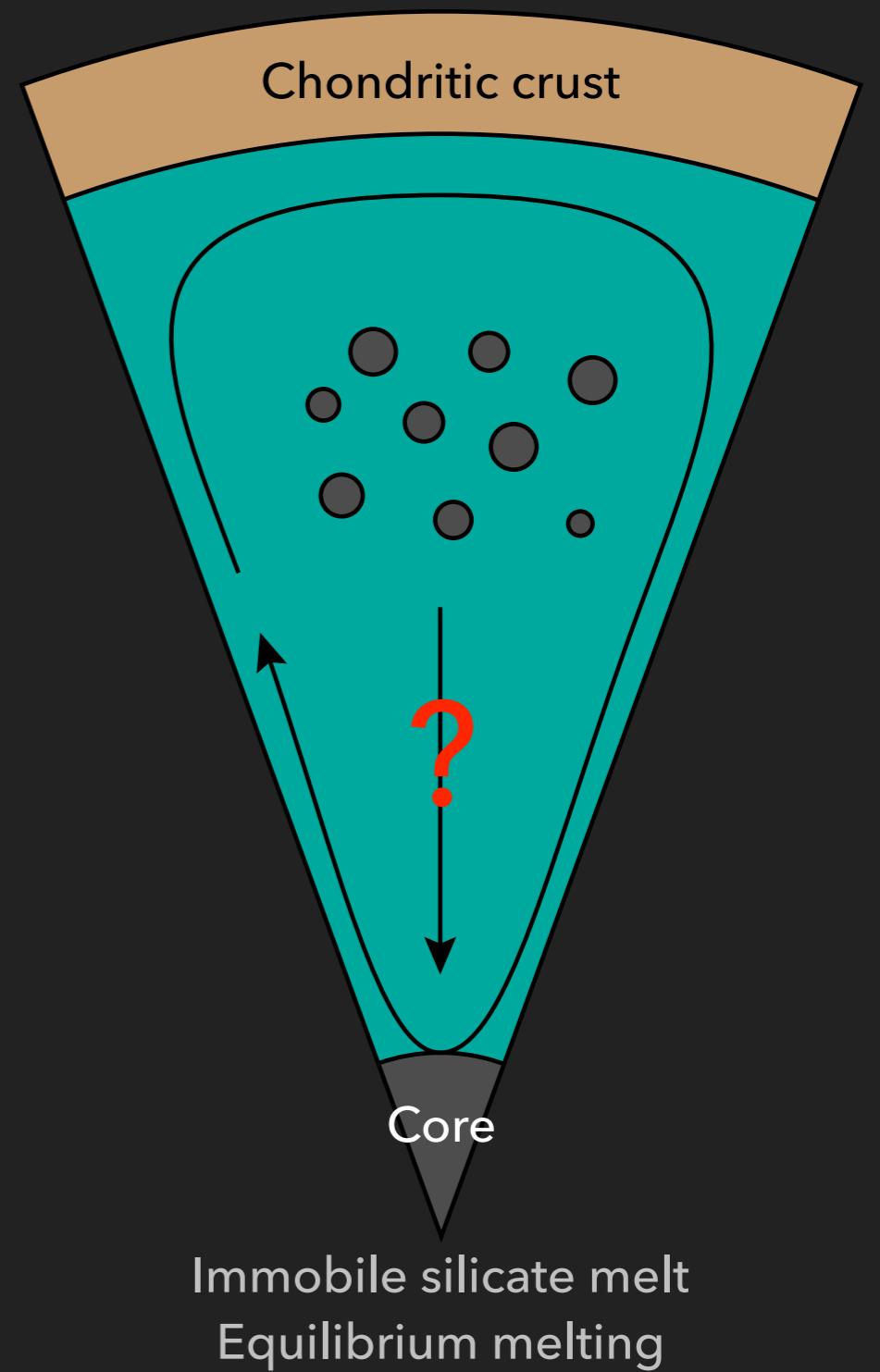
THE MAGMA OCEAN SCENARIO

$$Ra = \frac{\rho g \alpha \Delta T H^3}{\eta \kappa}$$



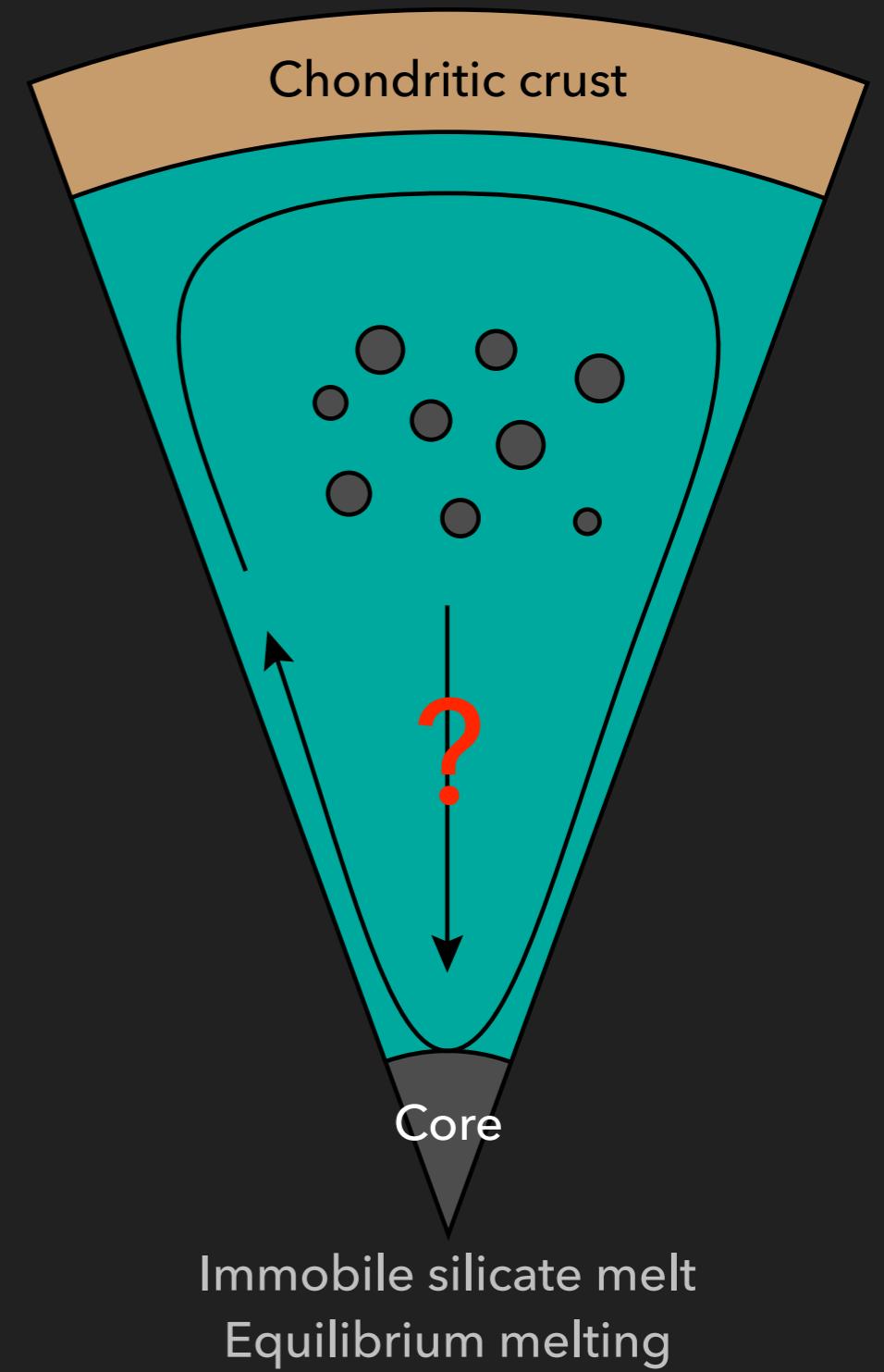
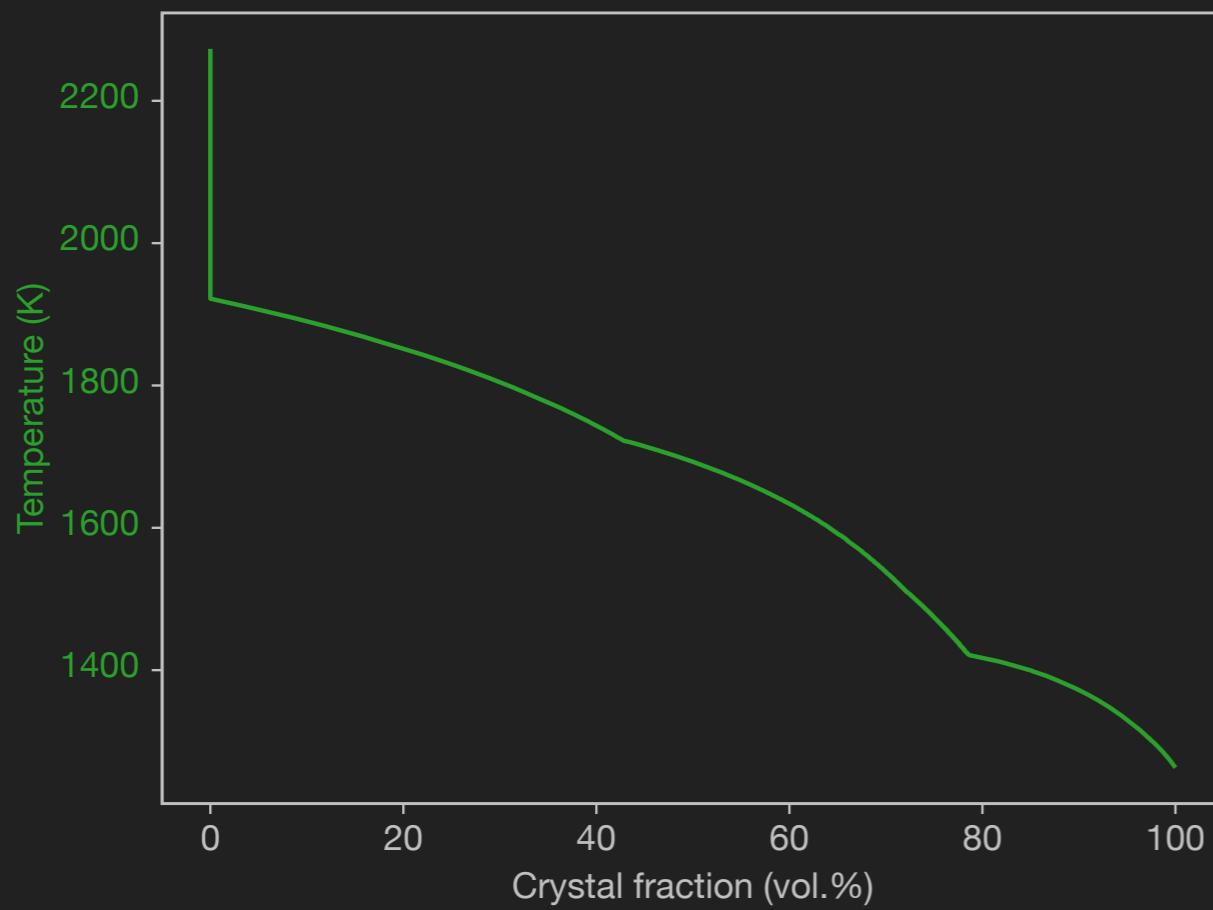
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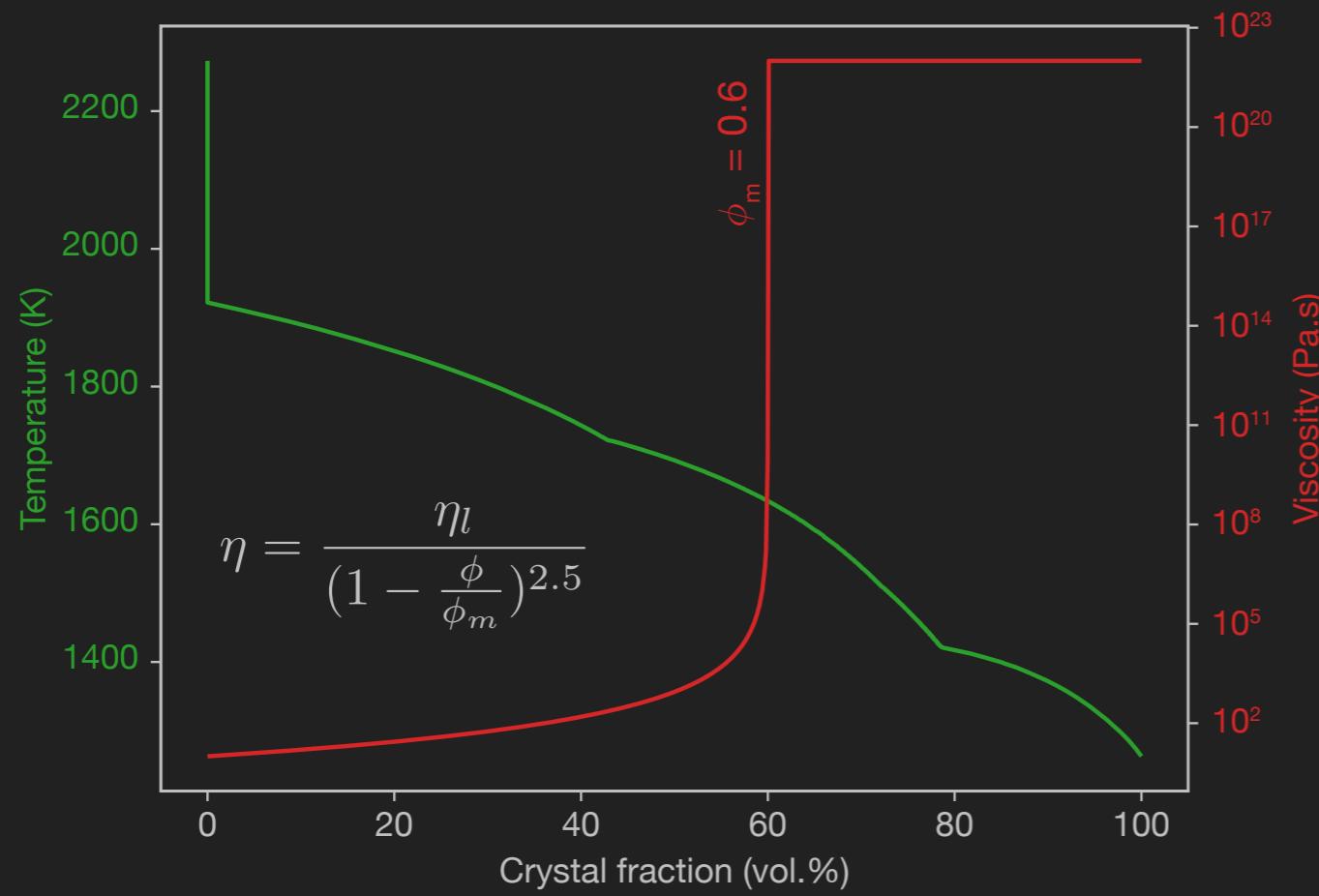
THE MAGMA OCEAN SCENARIO

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THE MAGMA OCEAN SCENARIO

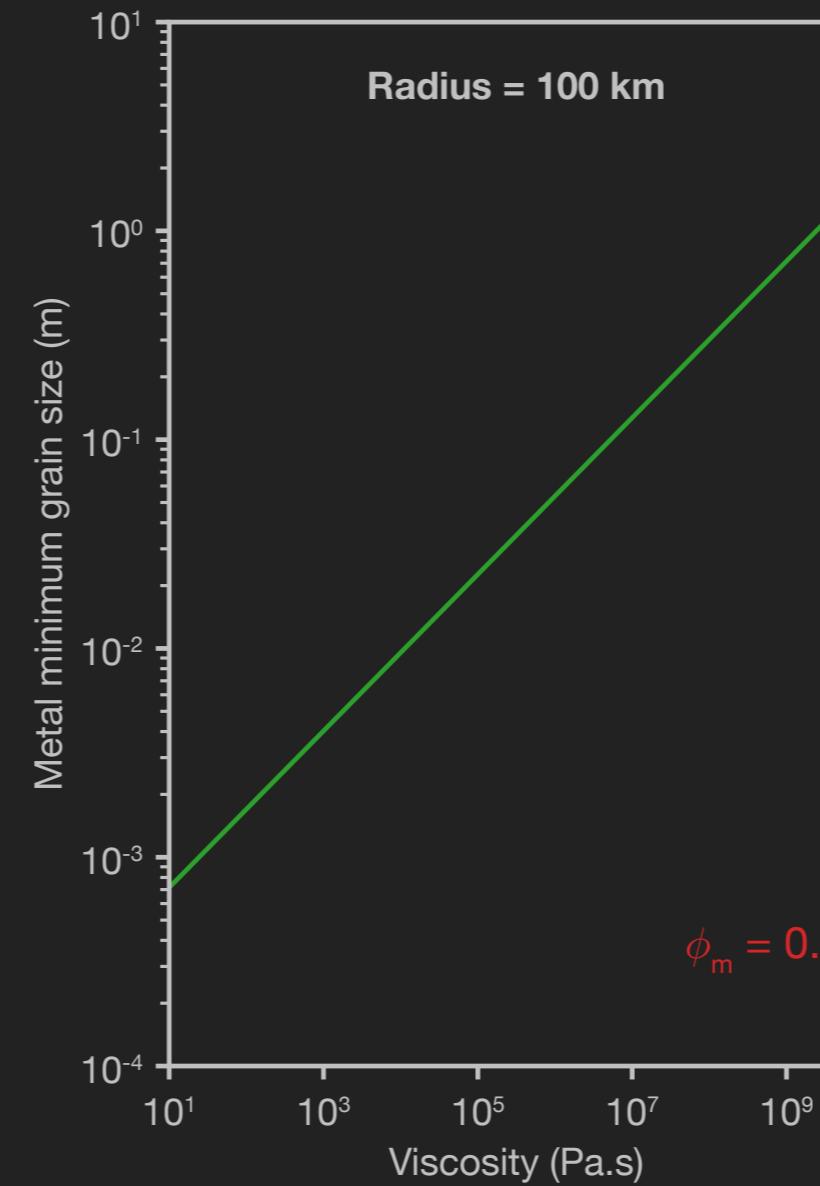
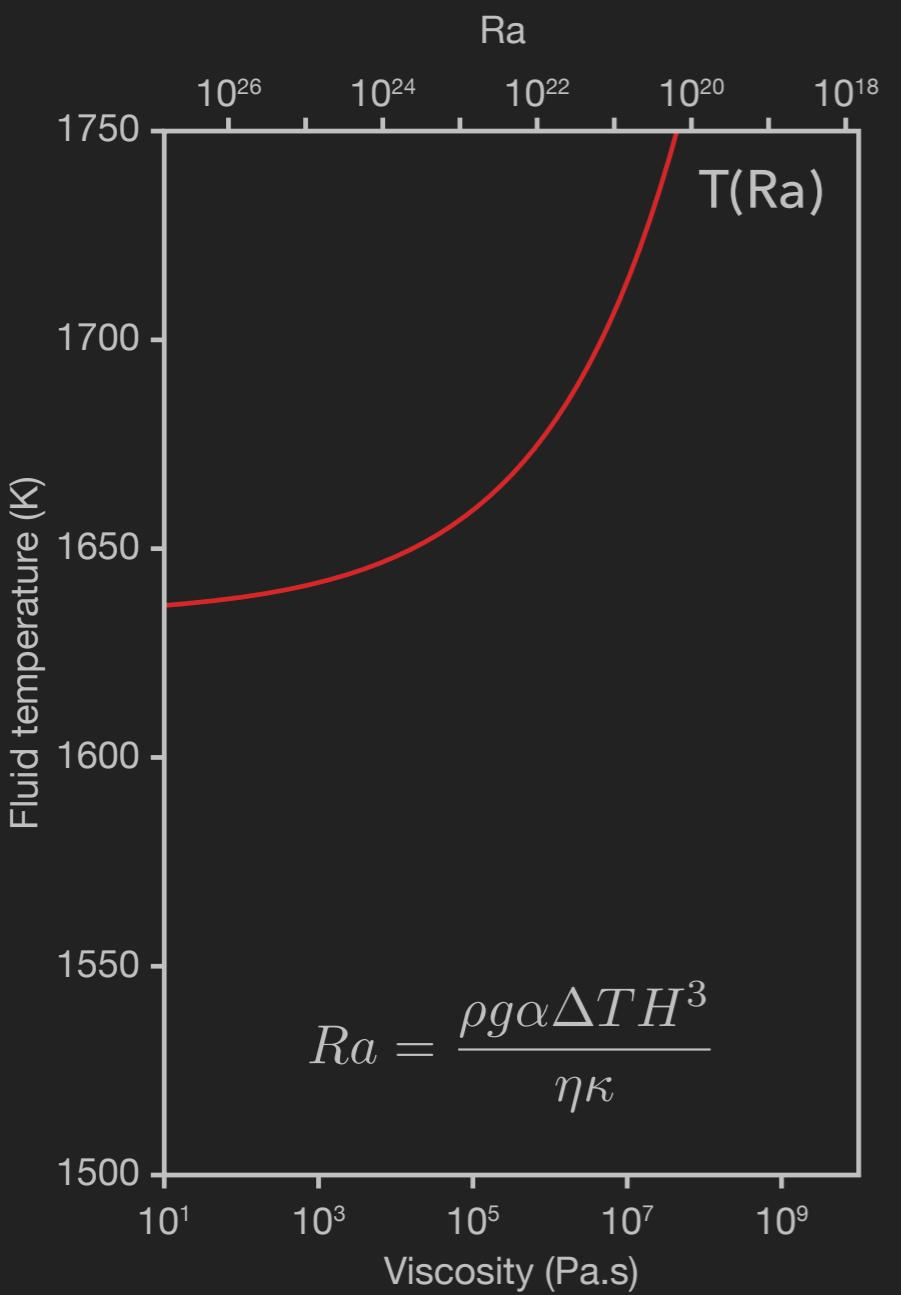
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Immobile silicate melt
Equilibrium melting

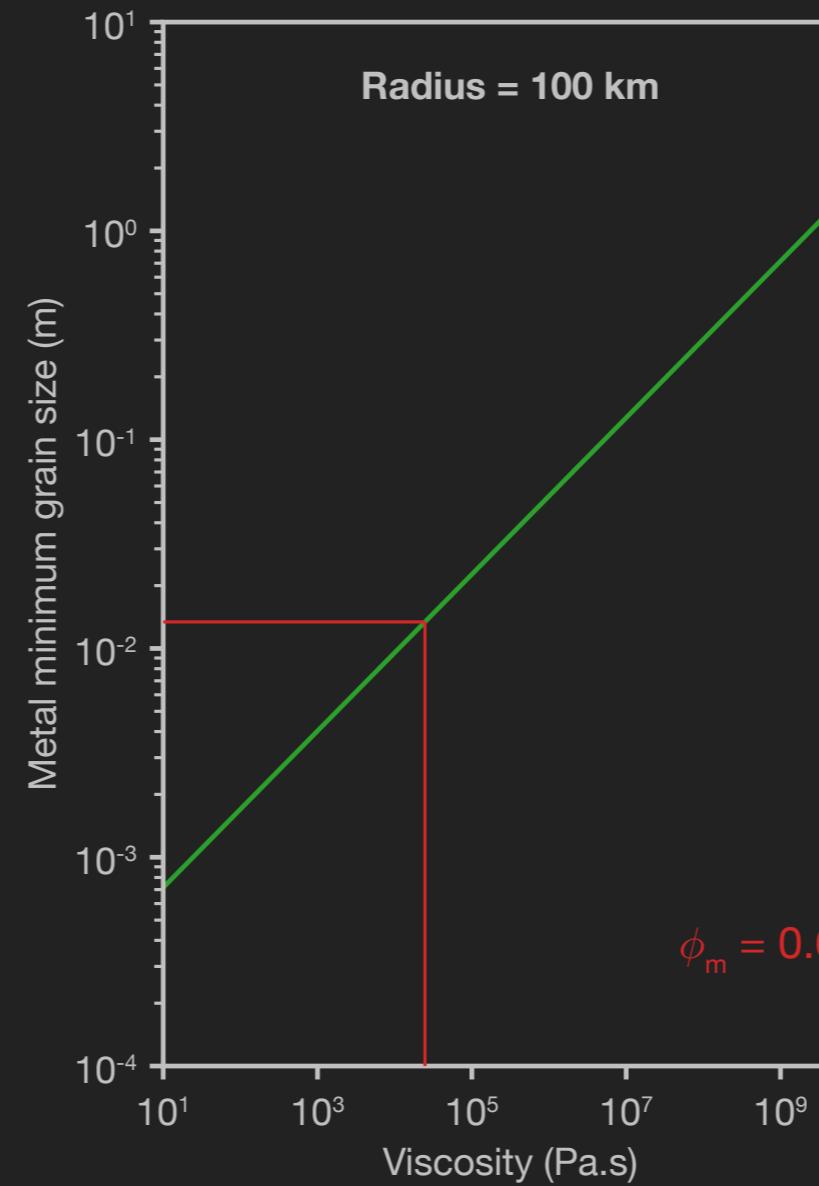
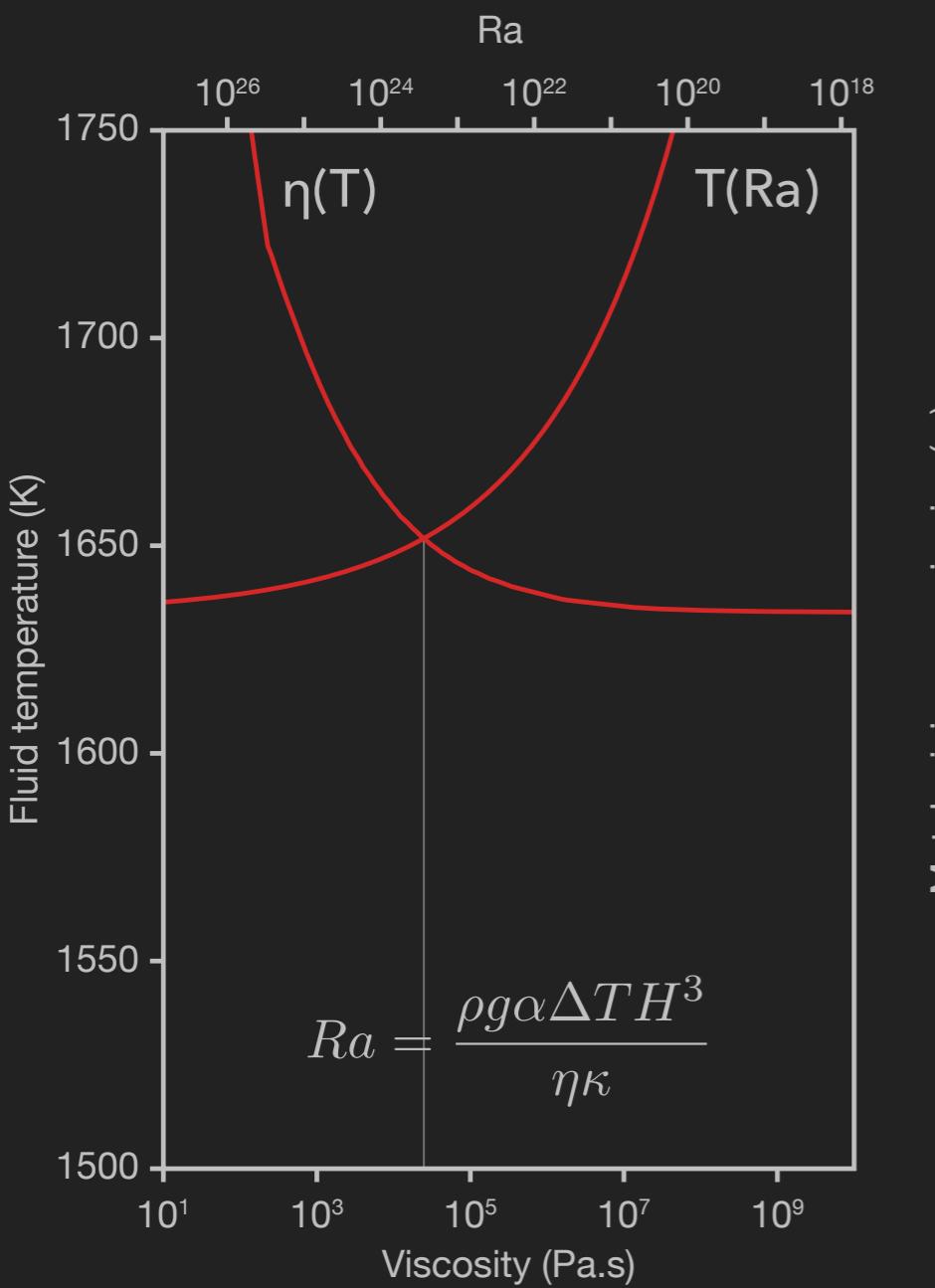
APPLICATION TO PLANETESIMALS

CRITICAL SIZE FOR METAL DROPLET TO SINK ?



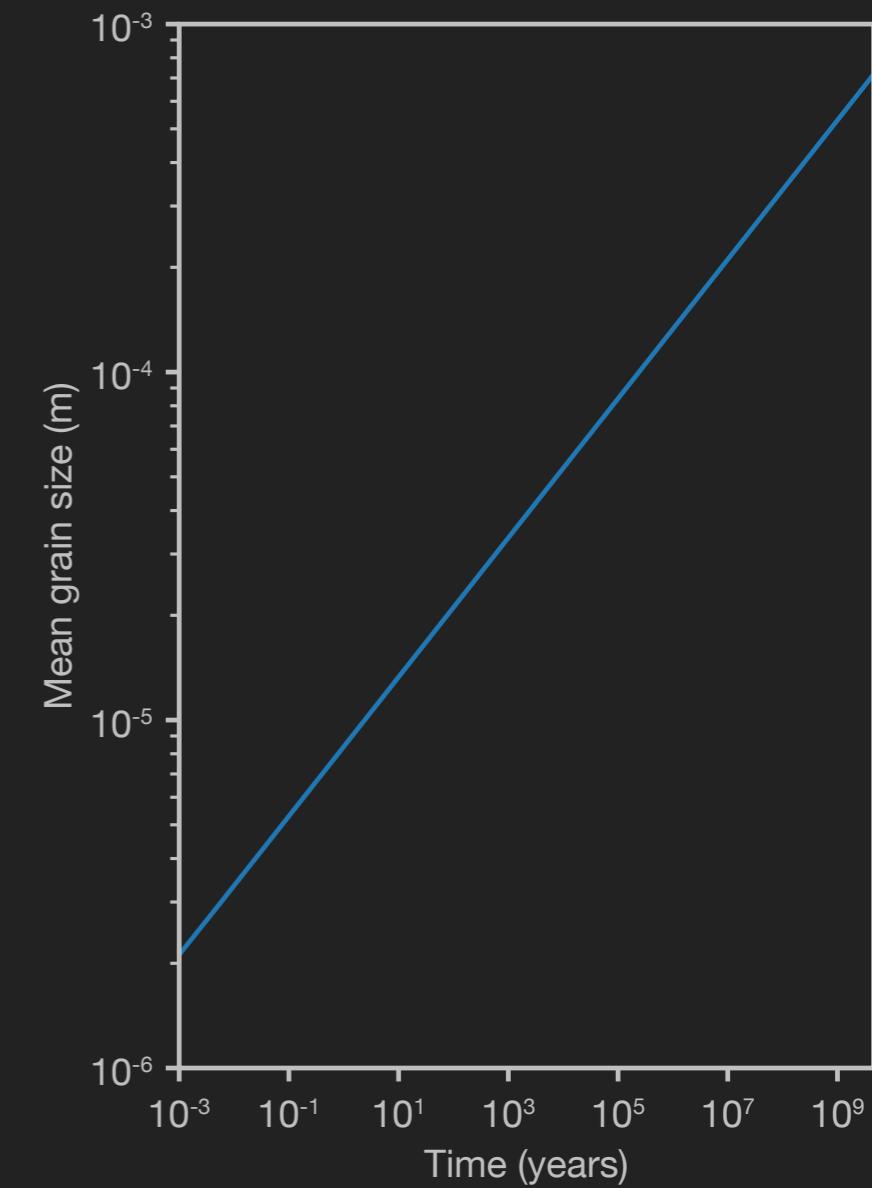
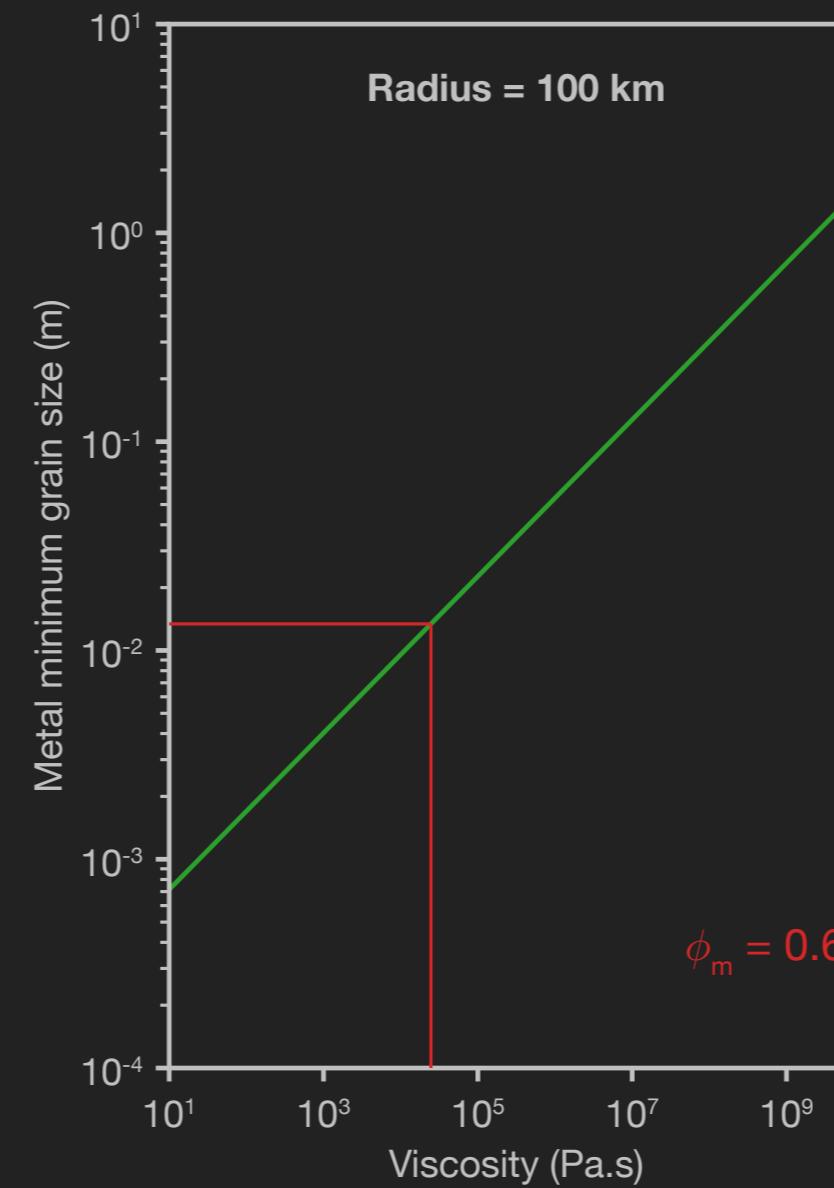
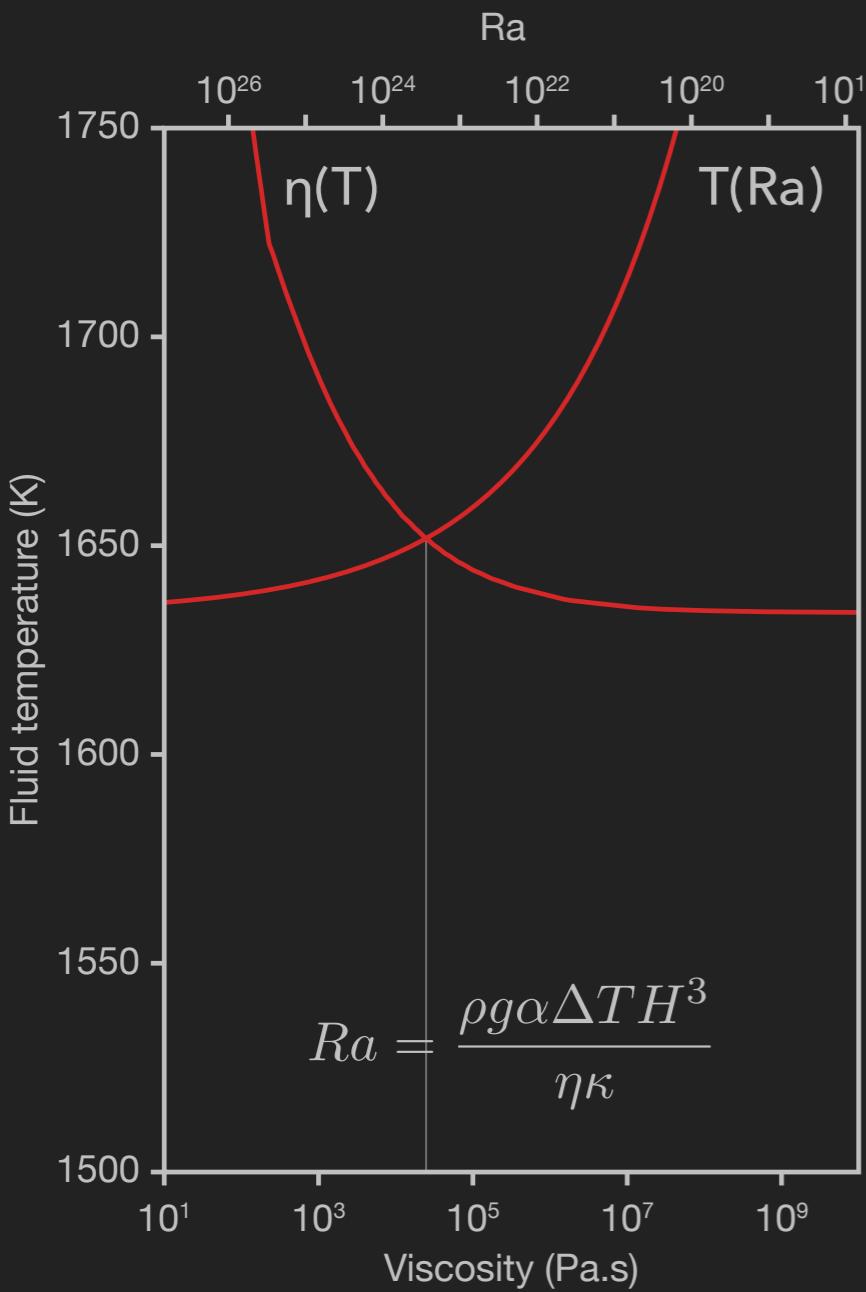
APPLICATION TO PLANETESIMALS

CRITICAL SIZE FOR METAL DROPLET TO SINK ?



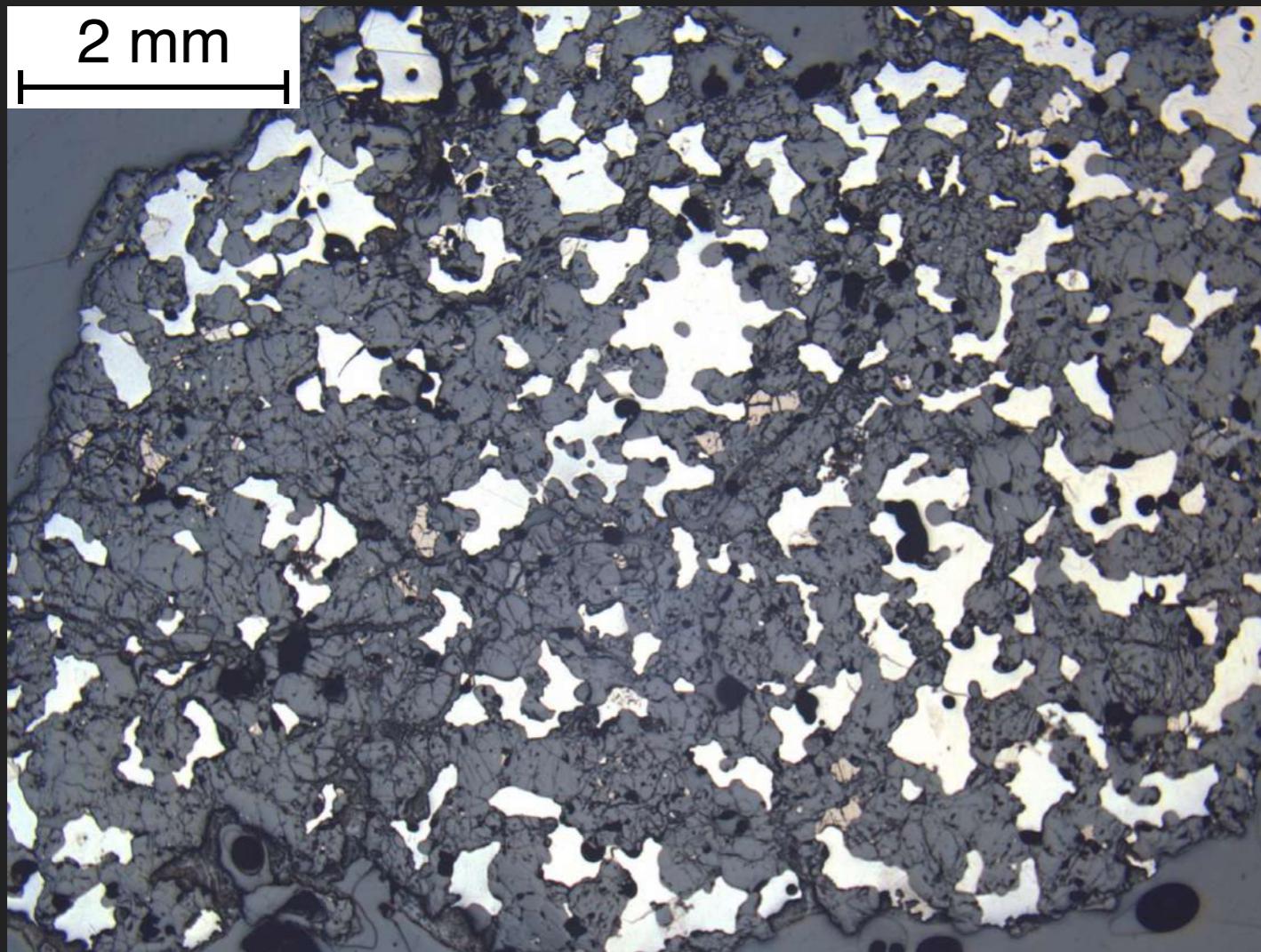
APPLICATION TO PLANETESIMALS

CRITICAL SIZE FOR METAL DROPLET TO SINK ?



EXPERIMENTAL PETROLOGY

A THREE-PHASE SYSTEM



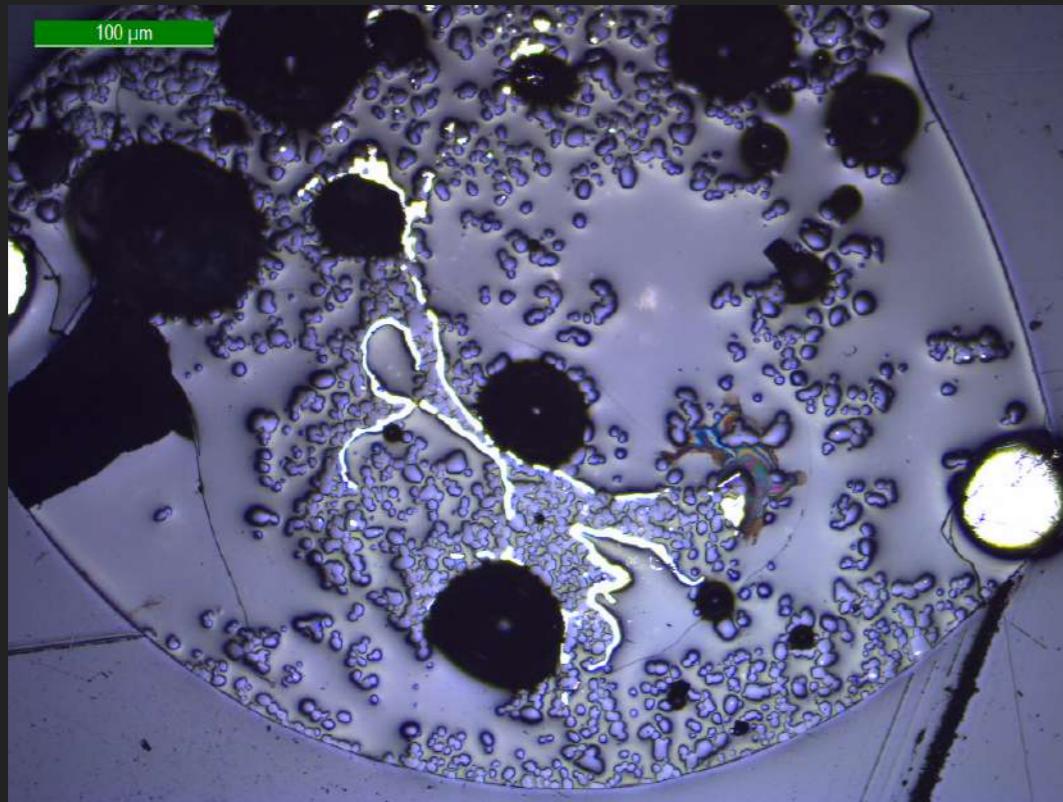
Natural Samples



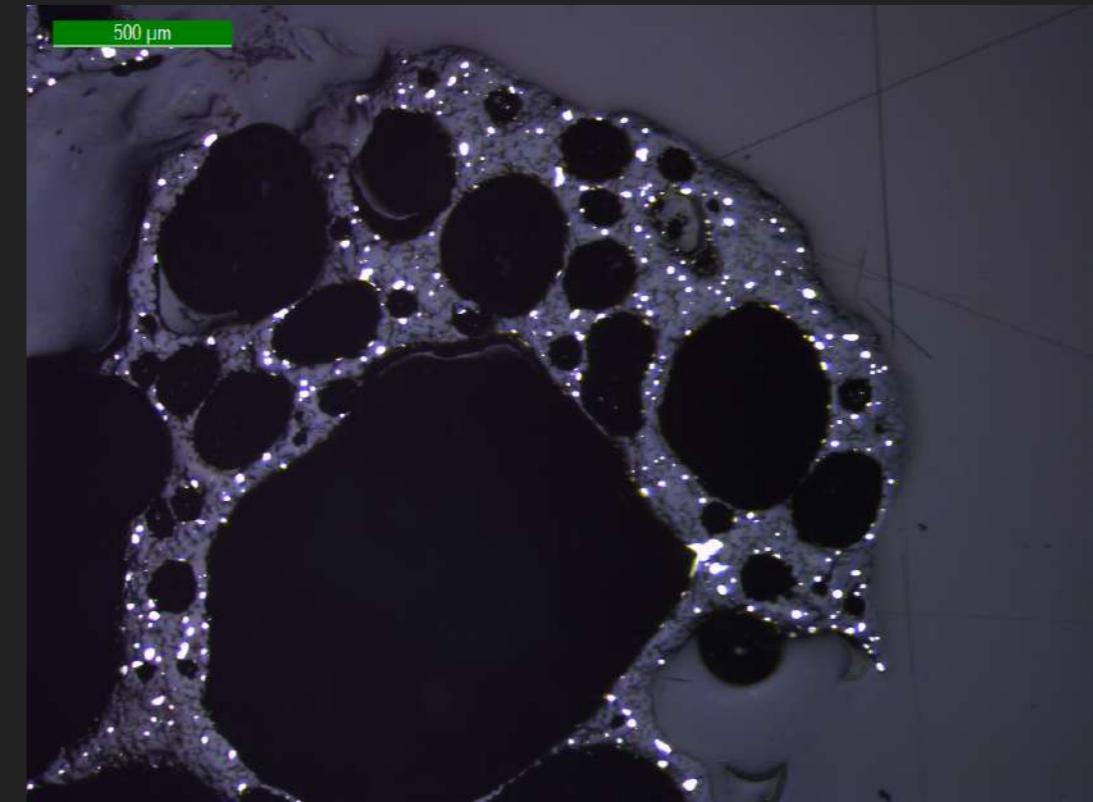
Atmosphere furnace
experiments

EXPERIMENTAL PETROLOGY

ATMOSPHERE FURNACE EXPERIMENTS – THE RESULT



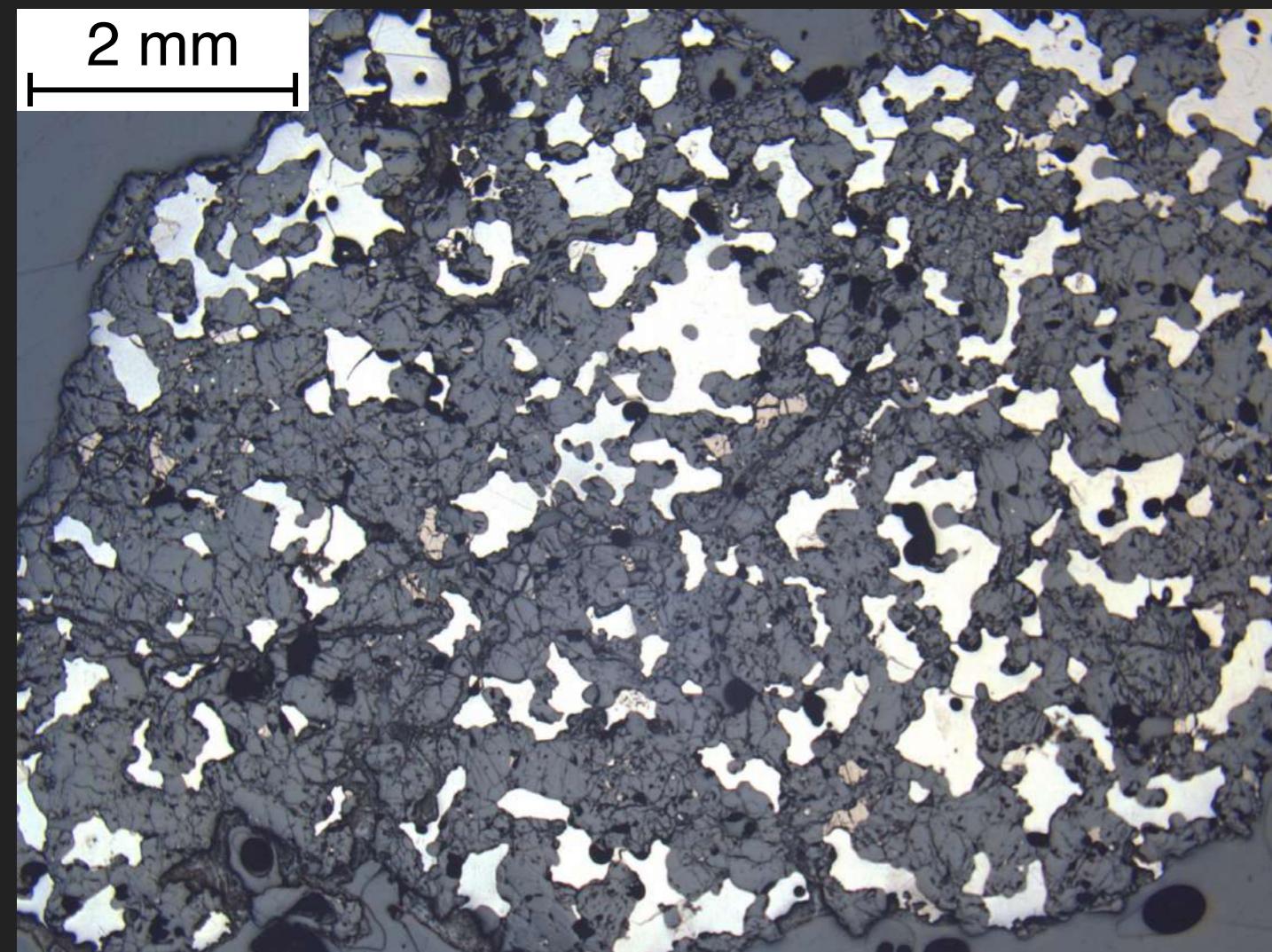
75 vol% Silicate melt
Magma ocean - like



32.5 vol% Silicate melt
Primitive achondrite - like

EXPERIMENTAL PETROLOGY

MORE EXPERIMENTS



Natural Samples



Atmosphere furnace

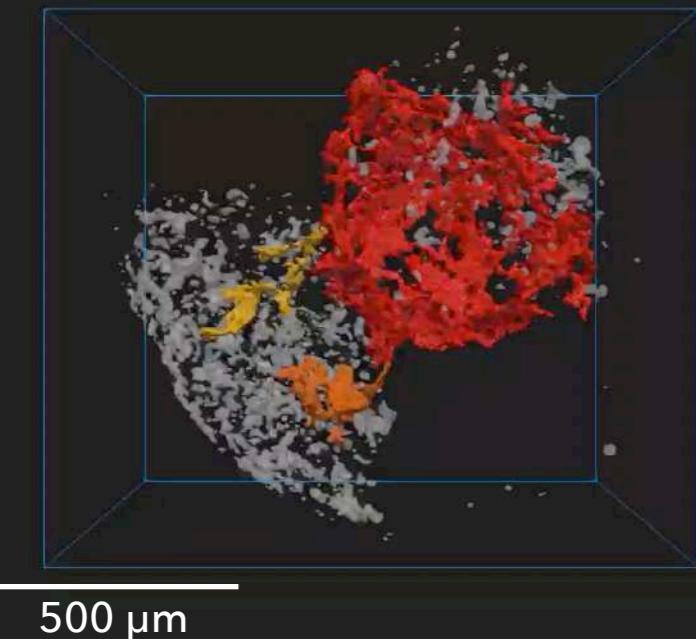


Piston-Cylinder
Experiments

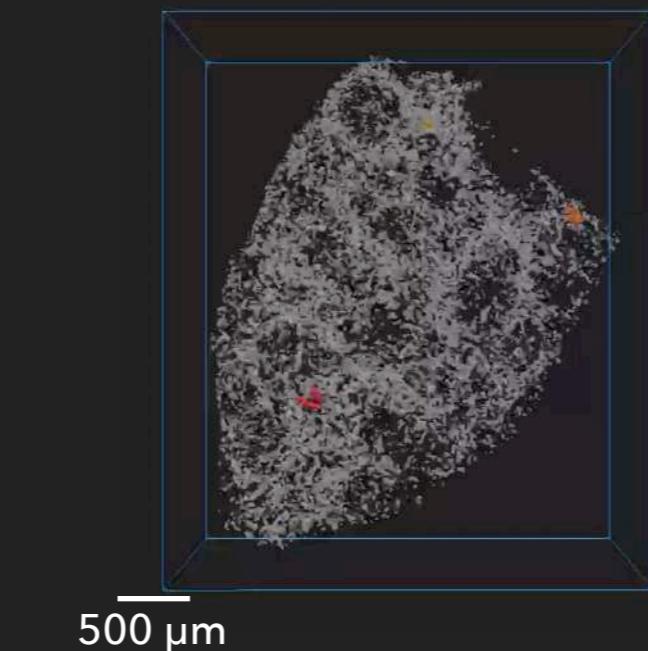
EXPERIMENTAL PETROLOGY

ATMOSPHERE FURNACE – PISTON-CYLINDER COMPARISON

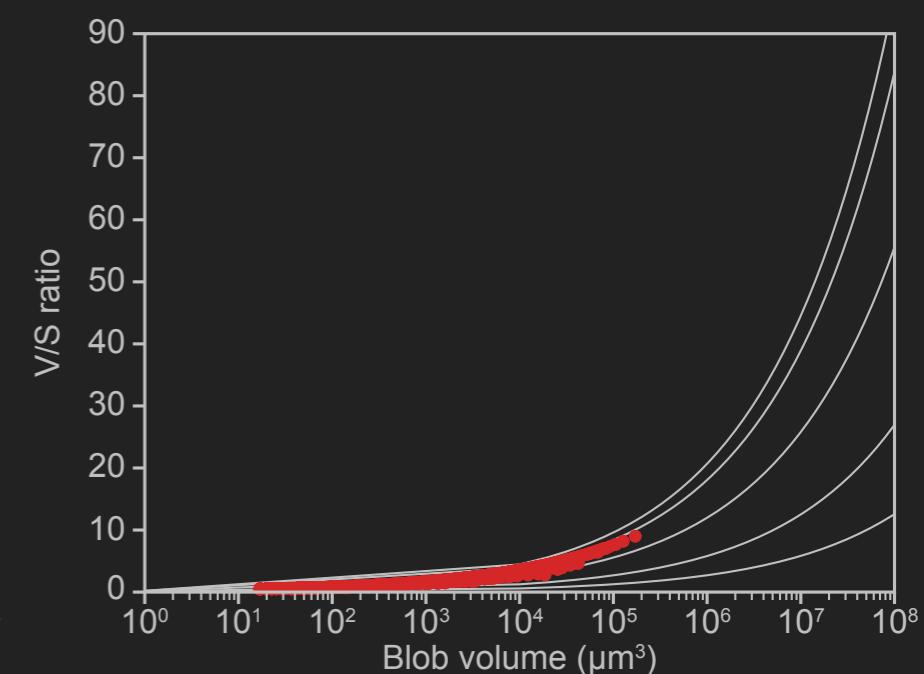
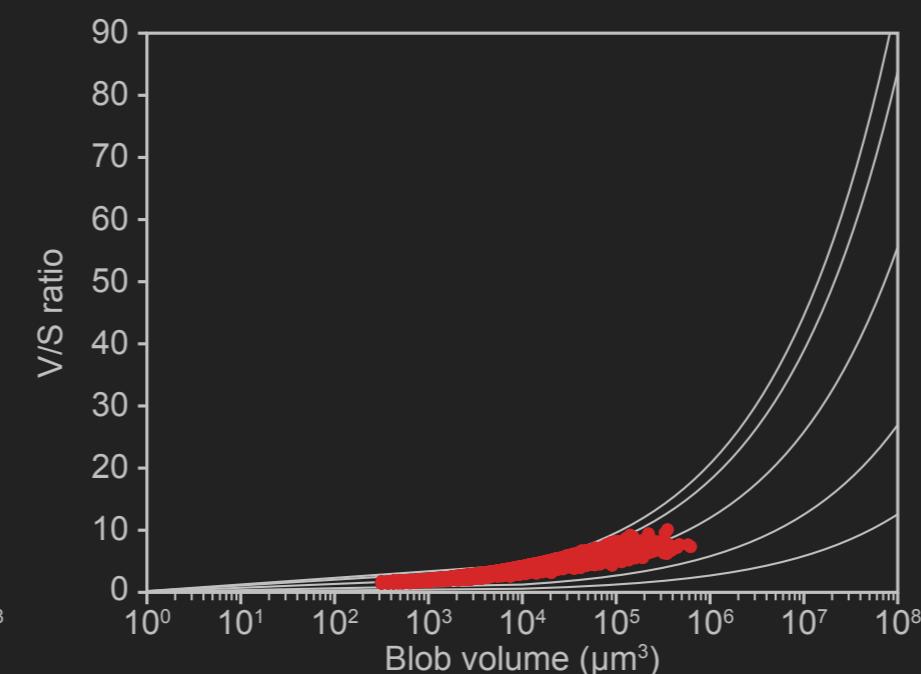
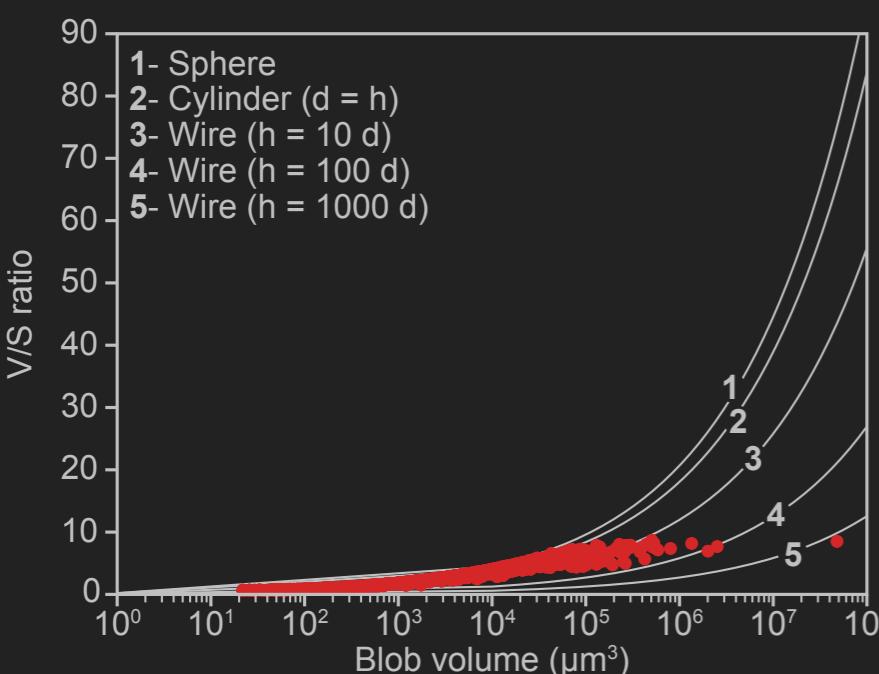
$\text{Ni}_{(s)}$ and 75 vol% silicate melt



$\text{Ni}_{(s)}$ and 32.5 vol% silicate melt



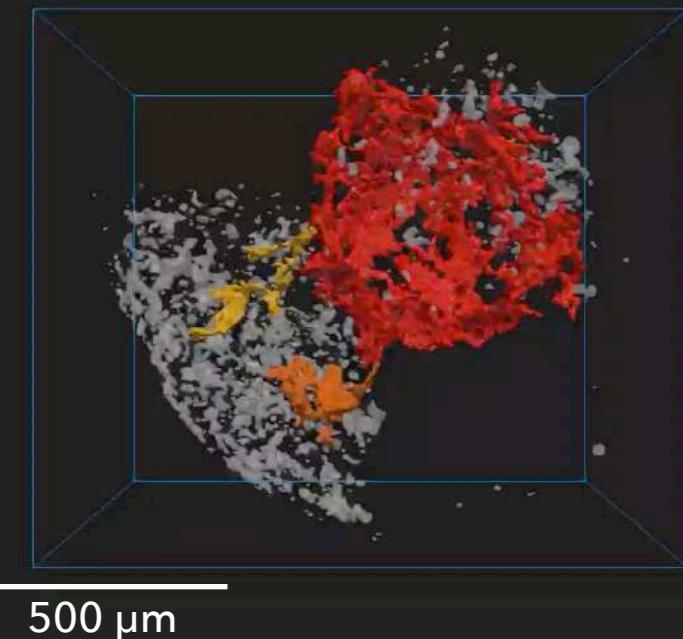
Experiment at 1 GPa



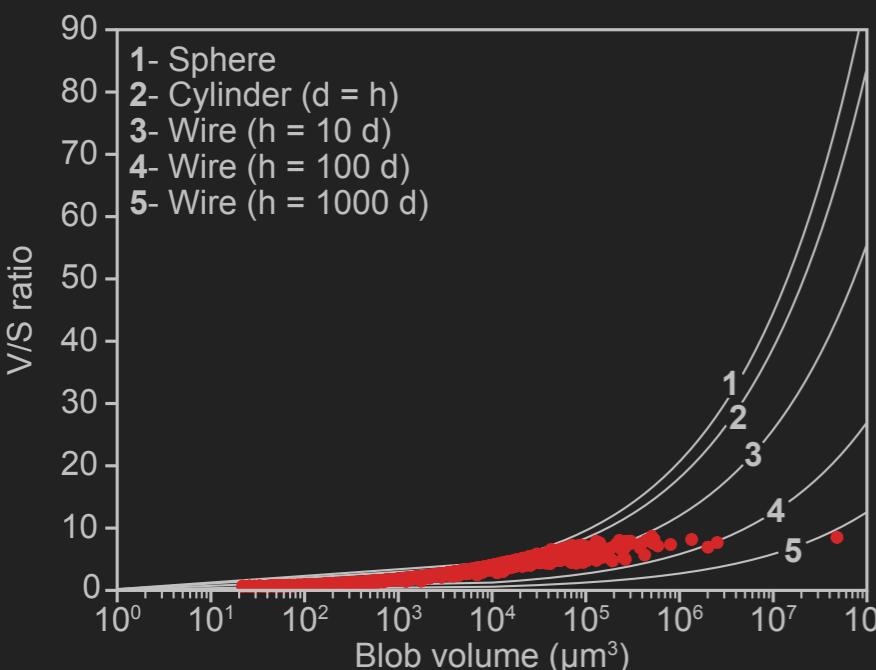
EXPERIMENTAL PETROLOGY

ATMOSPHERE FURNACE – PISTON-CYLINDER COMPARISON

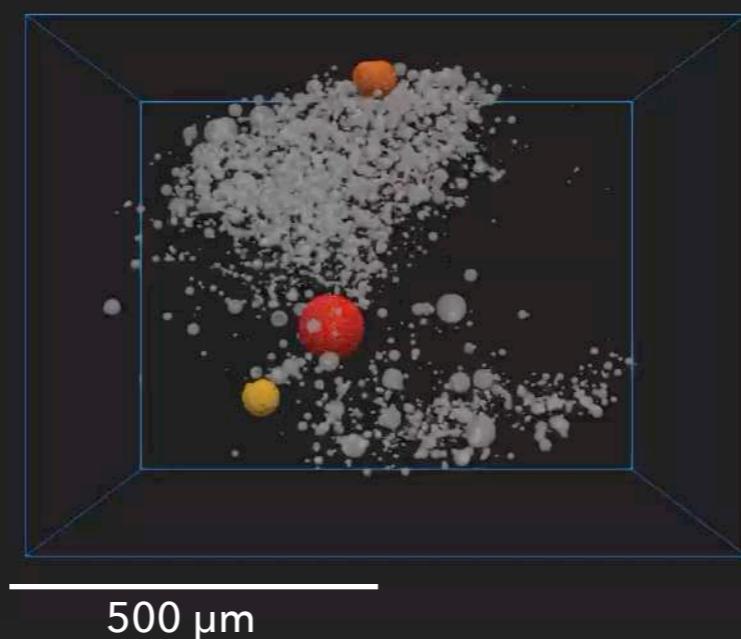
$\text{Ni}_{(\text{s})}$ and 75 vol% silicate melt



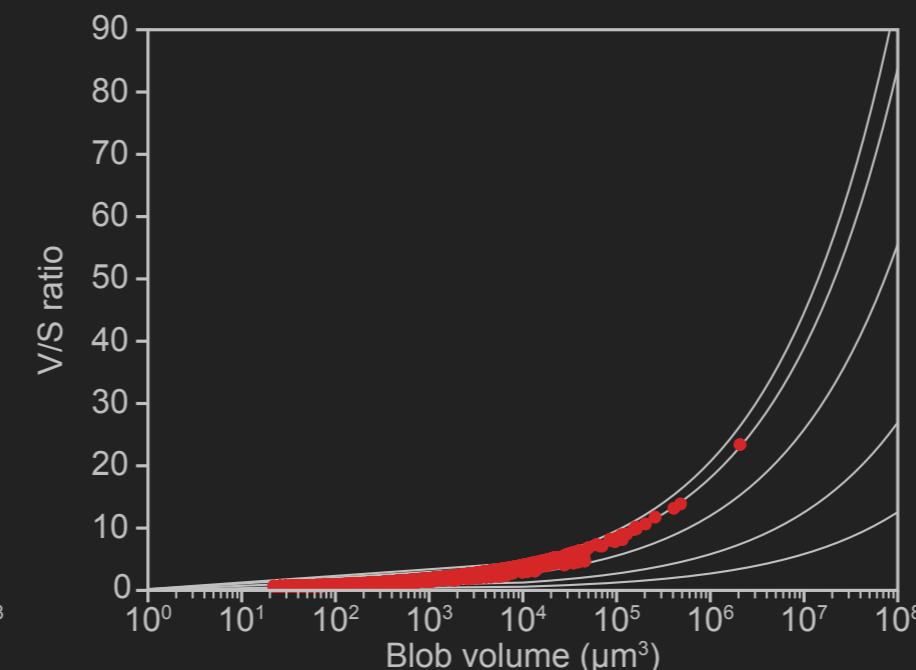
500 μm



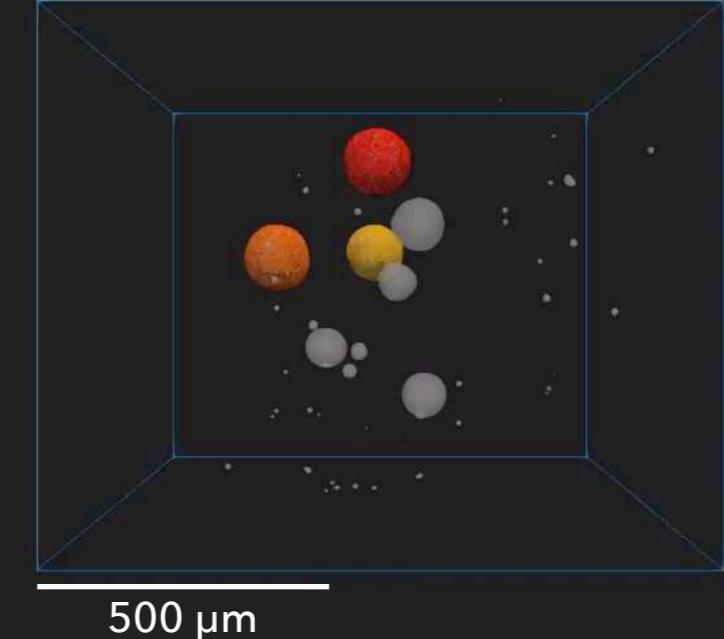
0.5 hours with $\text{Ni}_{(\text{l})}$



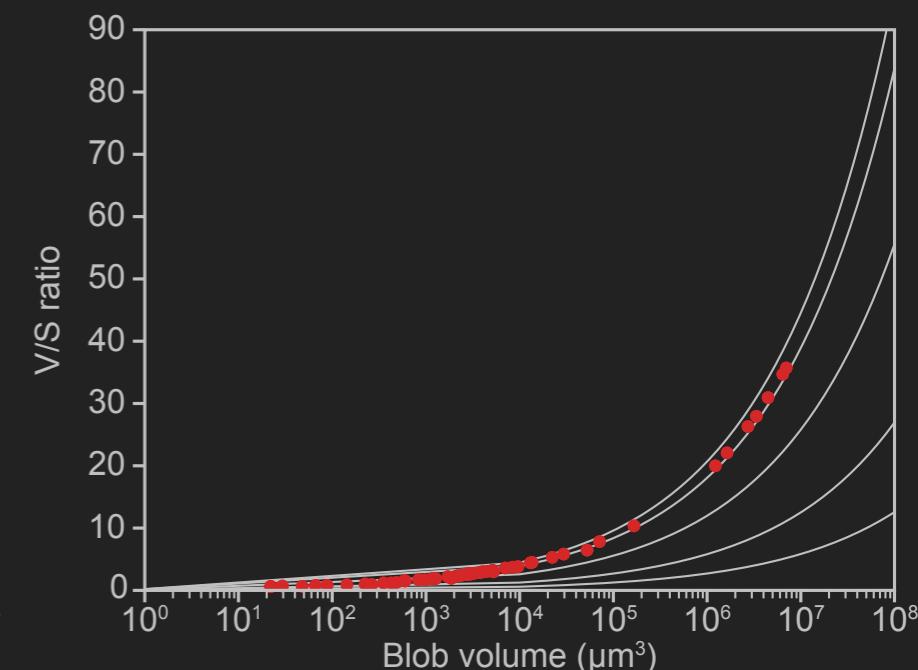
500 μm



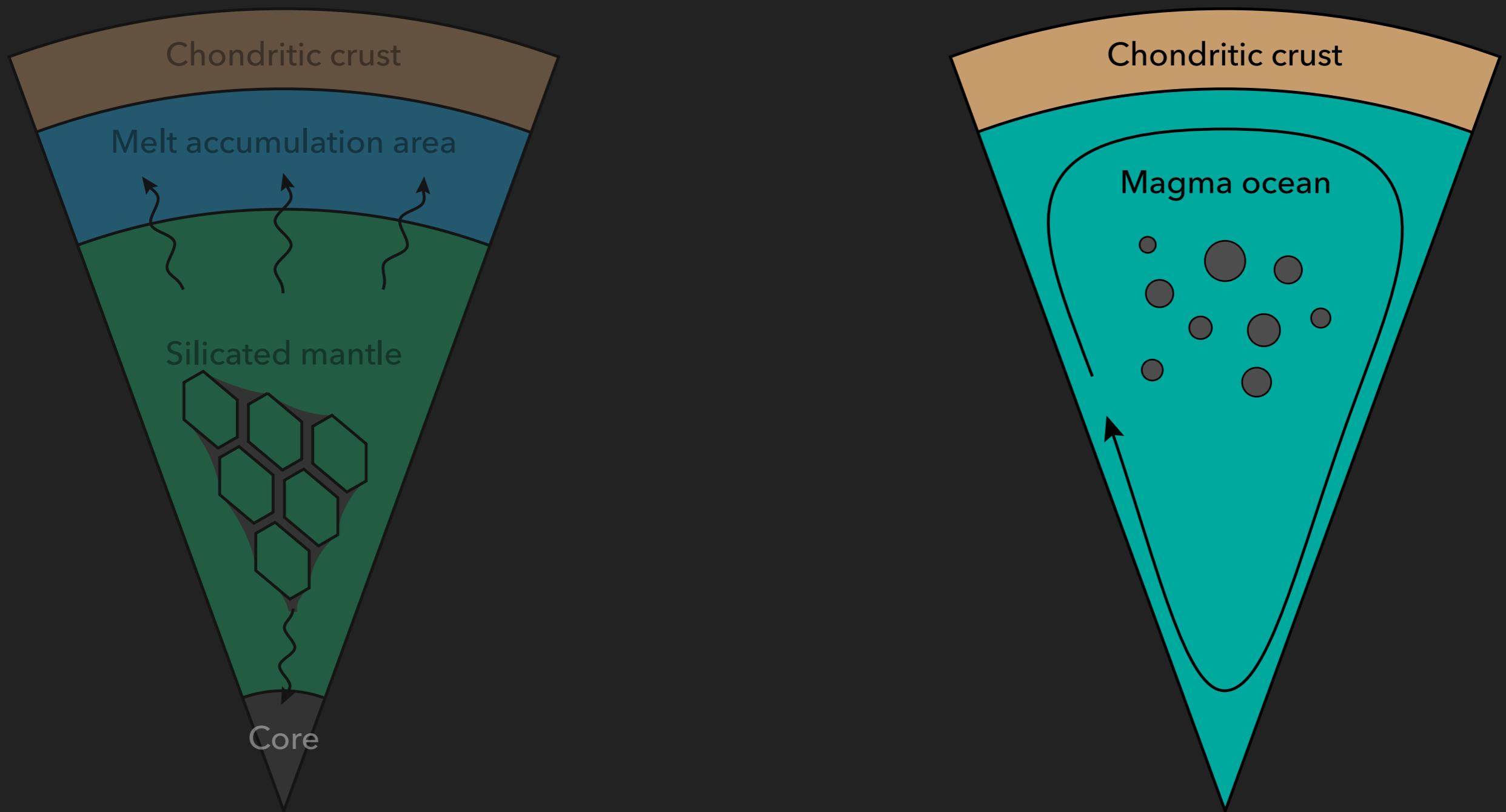
9 hours with $\text{Ni}_{(\text{l})}$



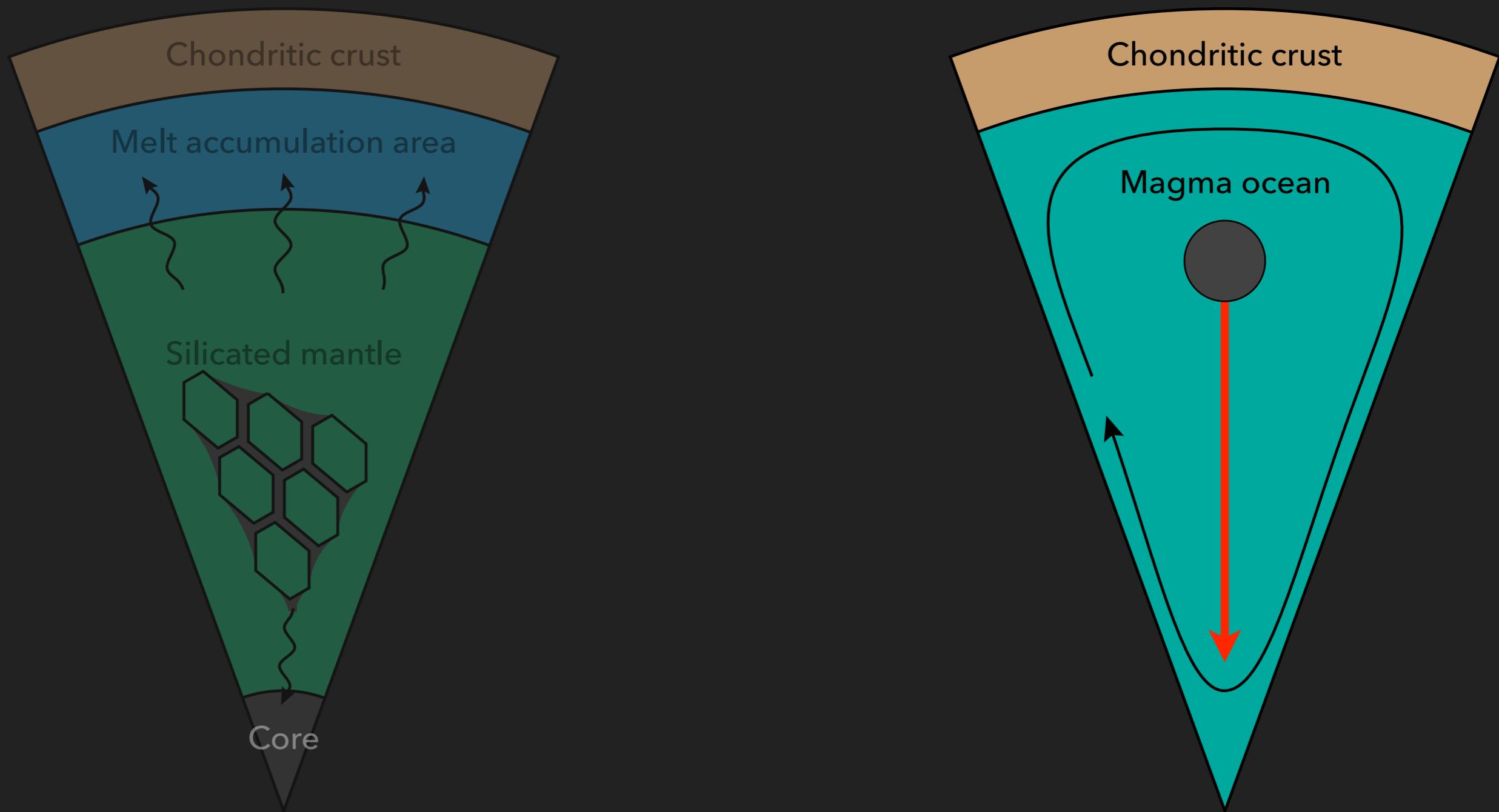
500 μm



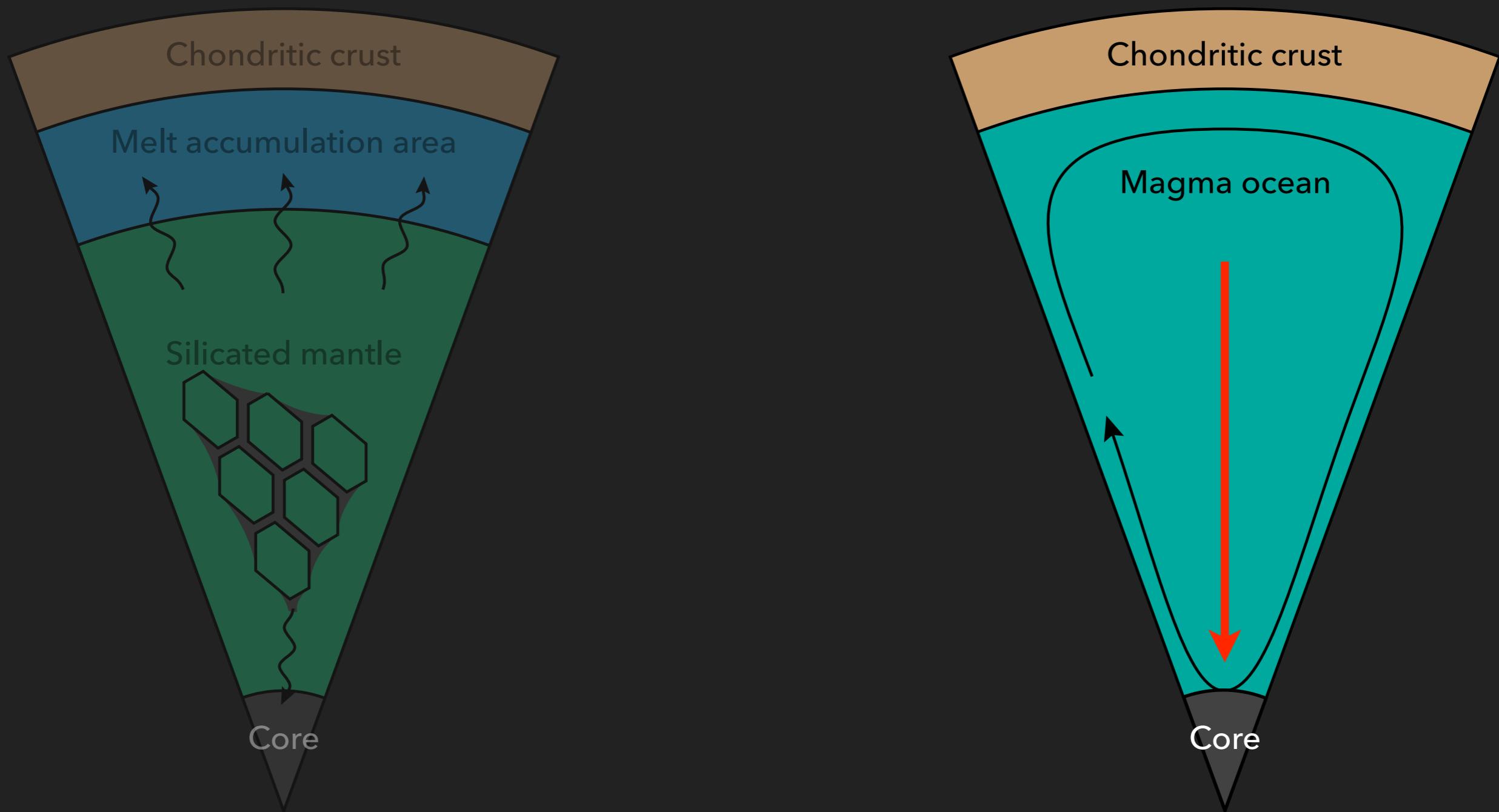
CONCLUSIONS



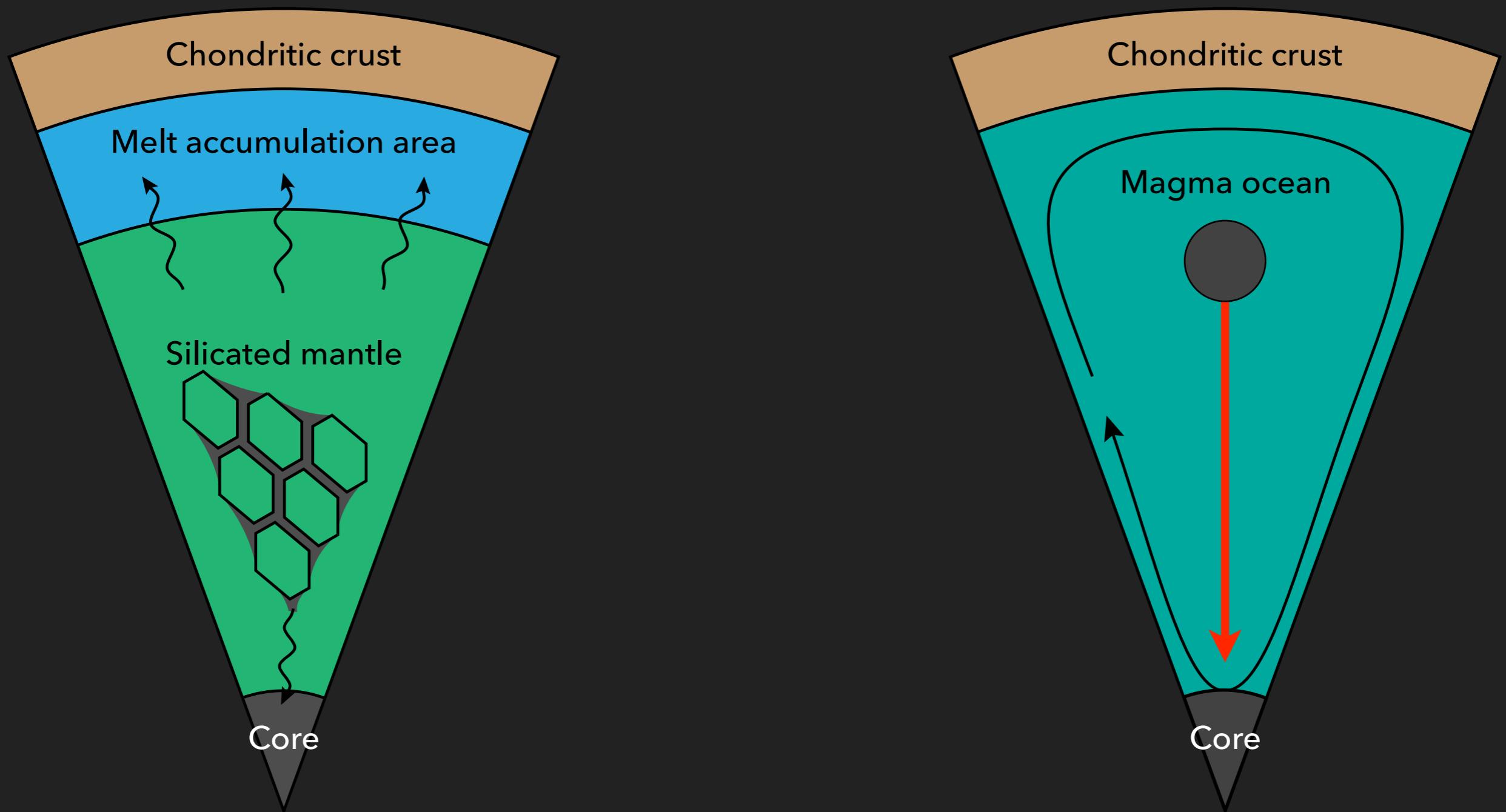
CONCLUSIONS



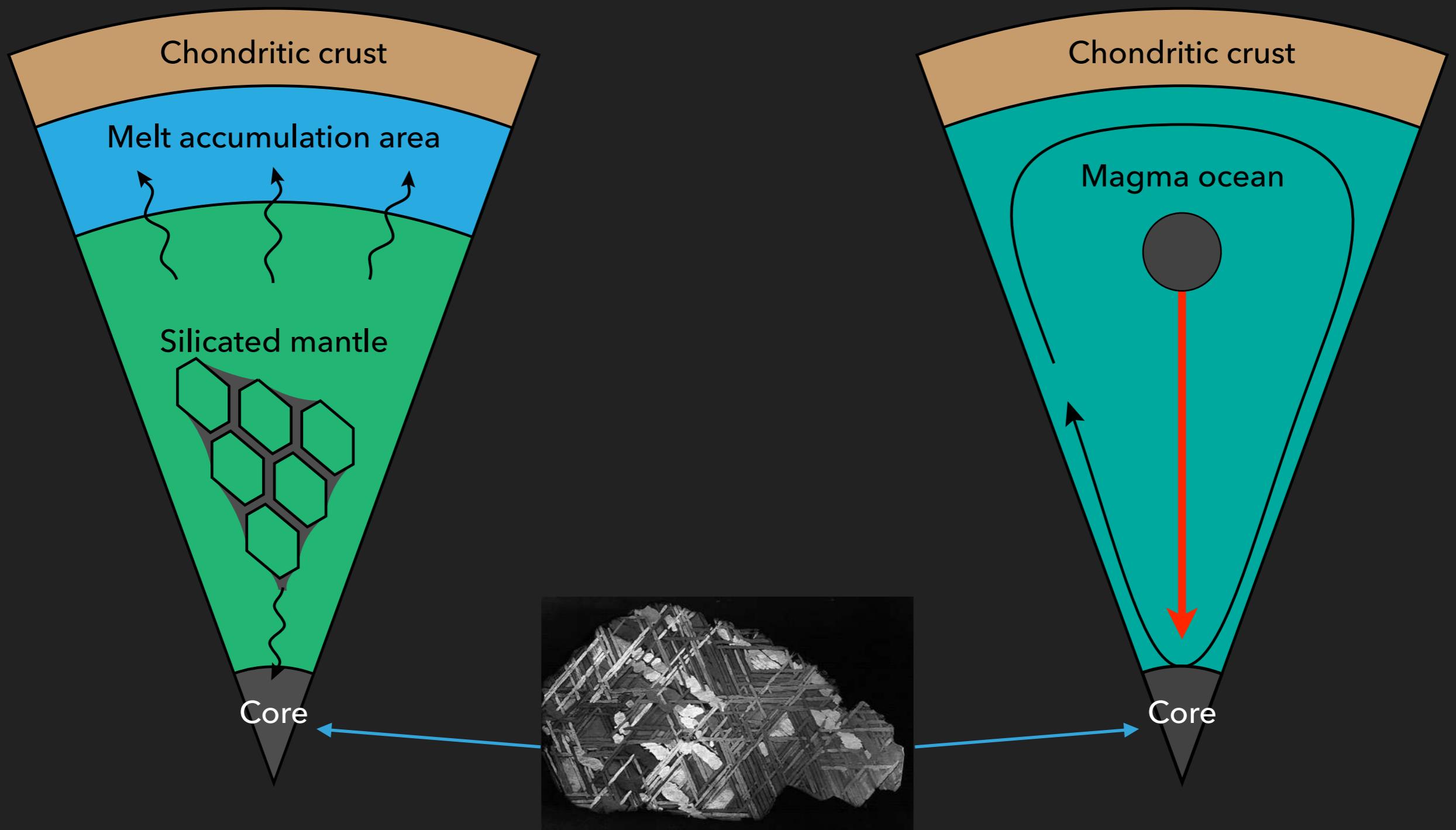
CONCLUSIONS



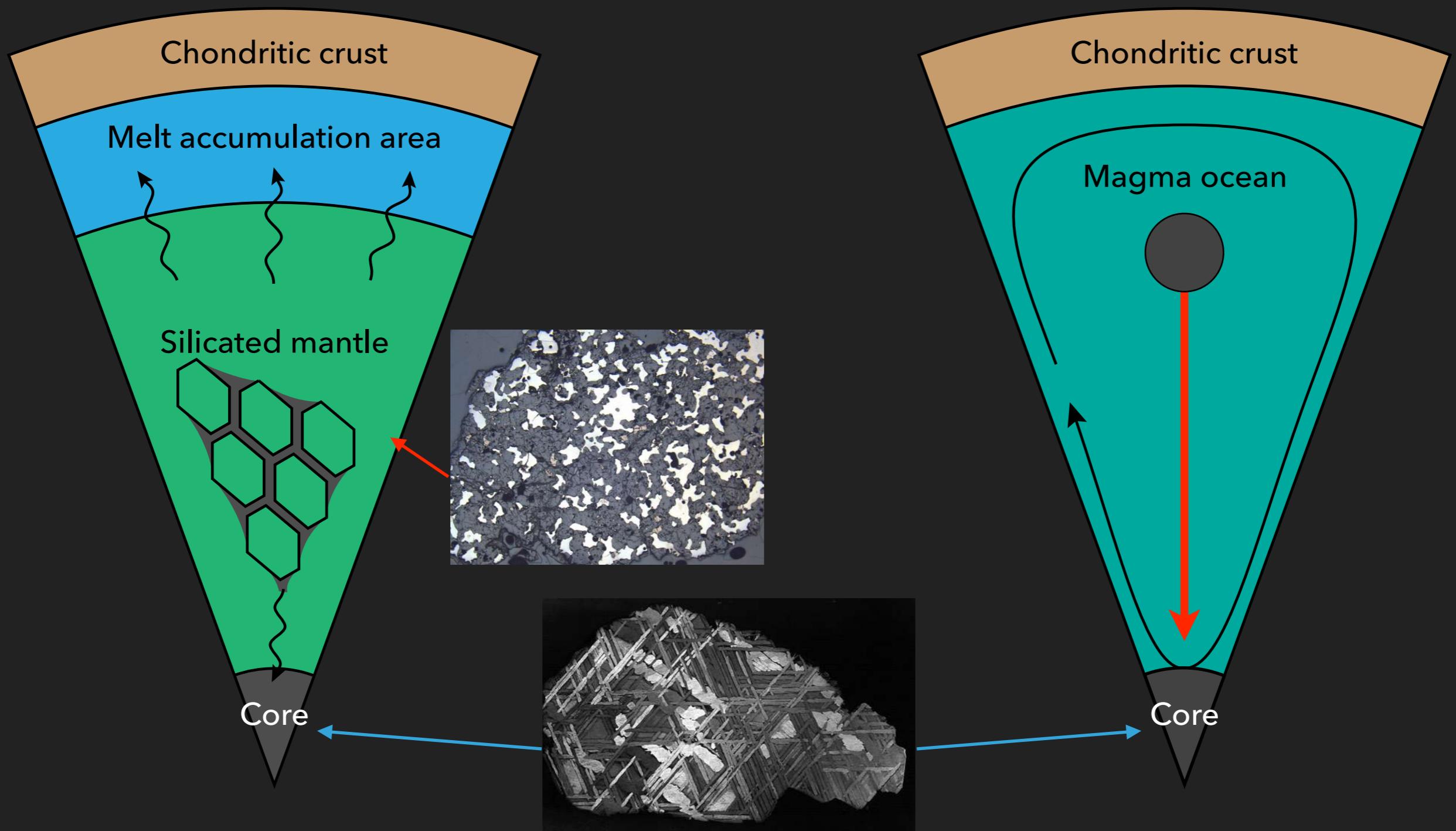
CONCLUSIONS



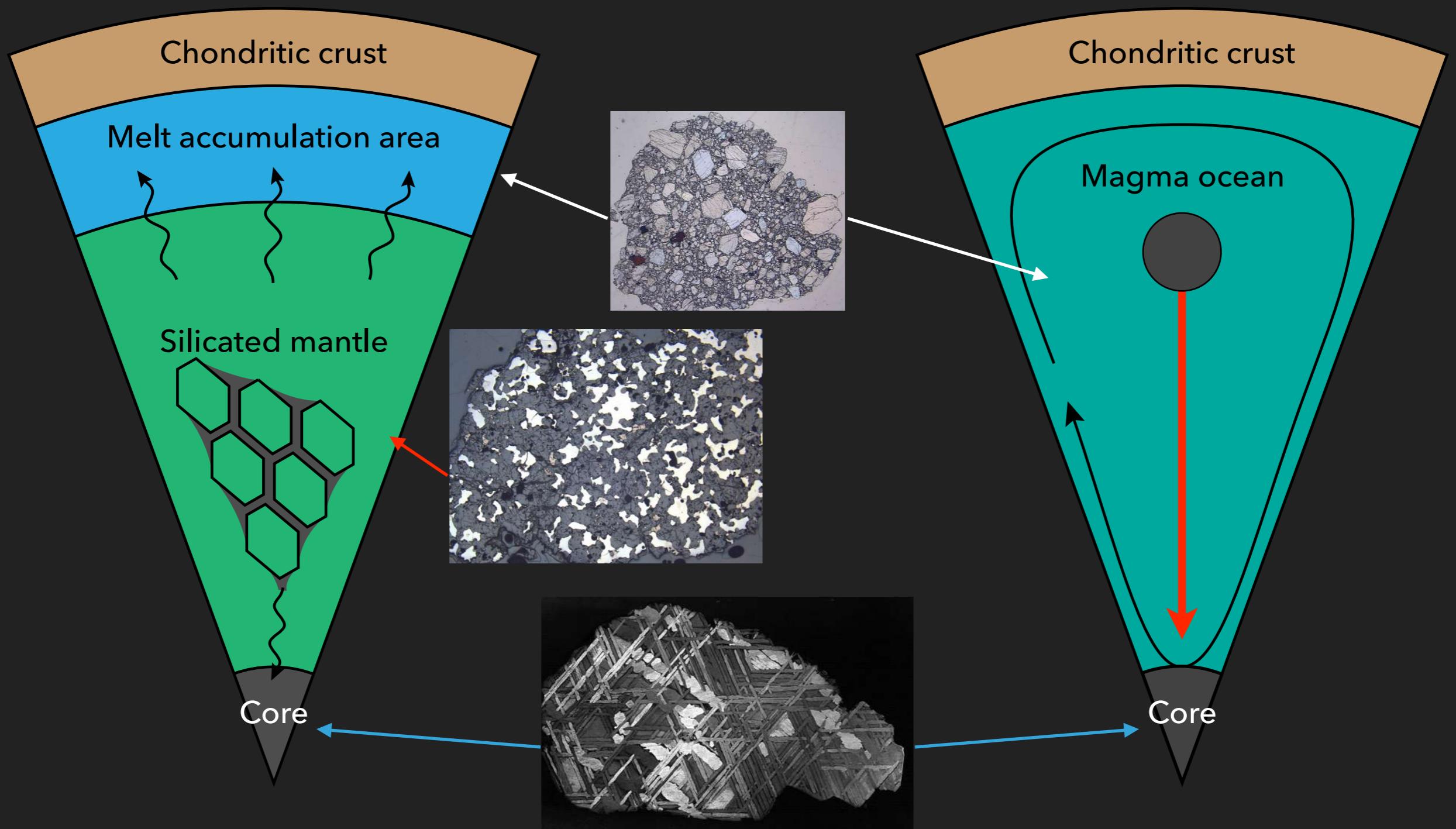
CONCLUSIONS



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