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The wetting properties of sulfide melt in the Earth's mantle: New insights from combined 2D and 3D imaging.

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Base-metal sulfur liquids (mattes) are key metasomatic agents and carriers of highly siderophile elements (HSE) in the Earth's mantle. While previous studies have focused on sulfur-poor metallic liquids linked to core formation, we conducted high-pressure experiments using a multianvil apparatus to examine how pressure, non-ferrous compounds, and silicate host mineralogy affect matte wetting properties. We tested conditions relevant to both the lithospheric (6 and 7 GPa) and sub-lithospheric mantle (13 GPa).

We analyzed matte behavior through dihedral angle measurements in backscattered-electron sections and 3D tomography scans. Our results show contrasting behaviors: mattes in olivine-dominated samples had high dihedral angles (94° and 100°), aligning with previous studies. However, at 13 GPa in a majorite-bearing sample, mattes formed a disseminated network with a mean dihedral angle of 43°, below the connectivity threshold of 60°. In a garnet-bearing host, the matte's dihedral angle decreased to 72°.

These findings suggest that pressure, coupled with mafic host mineralogy, enhances matte mobility in the sub-lithospheric mantle. Mattes in subducted oceanic crusts may efficiently transport HSE into surrounding lithologies. In contrast, those within depleted, harzburgitic lithologies and ambient mantle are more likely to remain trapped at low melt fractions.