

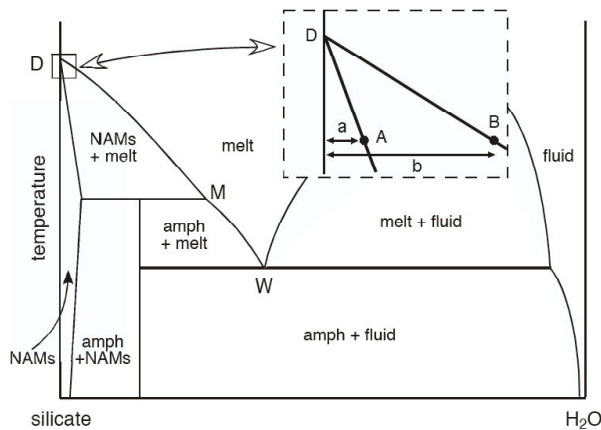
The effect of H₂O on the spinel peridotite solidus

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The effect of H₂O on the solidus of peridotite may be explained with a schematic phase diagram. D is the dry solidus, at which the “Nominally Anhydrous Minerals” or NAMs coexist with melt; W is the wet solidus, at which amphibole ± NAMS coexist with melt and supercritical fluid. Dehydration melting from amphibole breakdown occurs at M. The liquidus from D to M is the trace of the multiply-saturated (ol+opx+cpx±sp) melting curve as a function of H₂O content of the melt, which has been determined in CaO-MgO-Al₂O₃-SiO₂ at 1.1 GPa [1]. If H₂O were not to dissolve in NAMS, the smallest amount of H₂O in the bulk composition would produce melt at M (or at W, if amphibole were less stable), 100s of degrees below the dry solidus. But the depression of the dry solidus from small amounts of H₂O is controlled by the partitioning of H₂O between NAMS and melt, as shown in the inset, which may be quantified using the slope of the liquidus D to M (45°C/wt%H₂O [1]), and the bulk D(H₂O), the ratio b/a. Recent measurements give D(H₂O) = 0.002 for ol/melt, 0.019 for opx/melt and 0.023 for cpx/melt [2], hence bulk D(H₂O) = 0.01 for fertile spinel lherzolite. Olivine contributes insignificantly to the H₂O budget compared to pyroxenes. For 50 ppm H₂O in the source, the initial melt (F=0) will have 0.5 wt% H₂O, hence the depression of the dry solidus is only 22 °C. CO₂ diminishes this further [1].



References

- [1] Liu X, O'Neill HS, Berry AJ (2001) *J. Pet.* **47**, 409-434.
- [2] Aubaud C, Hauri EH, Hirschmann MM (2004) *Geophys. Res. Letters* **31**, Art. No. L20611.