

A theoretical study on oxygen isotope exchange between molten silicate and water vapor with large relative velocity

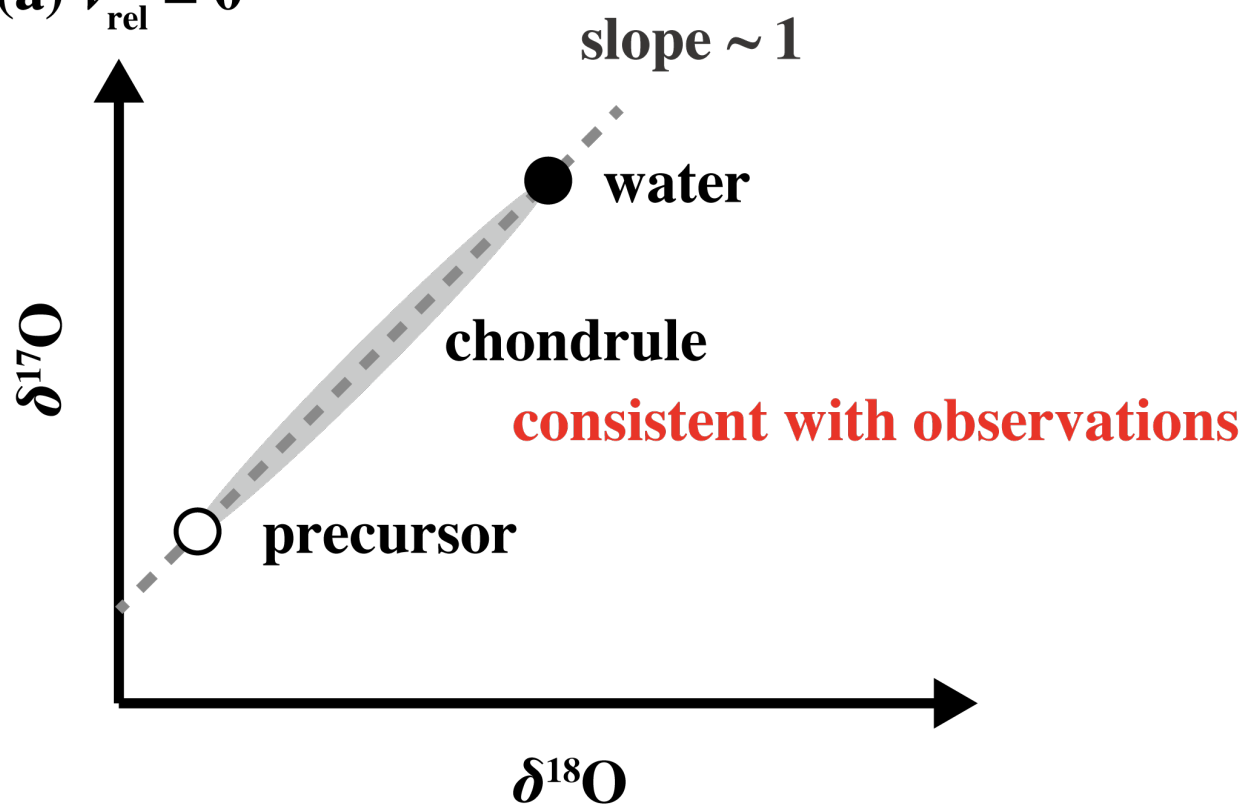
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Oxygen isotope compositions of chondrules reflect the environment of chondrule formation and its spatial and temporal variations. Here we present a theoretical model of oxygen isotope exchange reaction between molten silicate spherules and ambient water vapor with finite relative velocity, and we also discuss the plausible condition for chondrule formation from the point of view of oxygen isotope compositions. We found a new phenomenon, that is, mass-dependent fractionation caused by isotope exchange with ambient vapor moving with nonzero relative velocity. Our findings indicate that the relative velocity between chondrules and ambient vapor would be lower than several 100 m/s when chondrules crystallized.

Keywords: Oxygen isotope exchange, Chondrule, Molten silicate, Protoplanetary disk

(a) $v_{\text{rel}} = 0$



(b) $v_{\text{rel}} \gg 100 \text{ m/s}$

