

Discrepancy between geochemical and dynamical models of Moon formation in a giant impact

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Recent high-precision measurements of the O, Cr, K, and Si isotopic composition of lunar rocks, and of their Sm-Nd and Hf-W systematics, demonstrate that the bulk silicate Earth and the Moon show an unexpectedly high degree of similarity. This is not consistent with a giant impact model for the formation of the Moon. High-resolution smooth-particle hydrodynamic (SPH) simulations show that a grazing collision between the proto-Earth and a Mars-sized planet (Theia) can produce Earth-Moon systems with the correct masses, orbits, and angular momentum. However, all such simulations indicate that 70-80% of the mass of the Moon originates from Theia, not Earth [1]. This problem can not be solved by proposing that the proto-Earth and Theia formed at a similar distance from the Sun and hence were identical in composition. Their required size difference would lead to different P-T-time conditions for core formation and resulting differences in Hf-W and Si isotope systematics even in the absence of O isotope variations.

Resolution of this discrepancy without changing the main premises of the giant impact model requires complete isotopic homogenisation of Earth and Theia material after the impact. Turbulent exchange between partially molten and vaporized Earth and Moon shortly after the impact has been invoked to explain the similarity in O isotopes [2], but the effectiveness and dynamics of this mechanism are contested [3, 4]. Even if this process could explain the O isotopes similarity, it is unlikely to work for the much heavier, refractory elements.

Geochemical data therefore suggest that at a minimum, the SPH simulations that currently form the backbone of the evidence for a giant impact lunar origin incorrectly describe post-impact material transport and mixing. Alternatively, the Moon was formed from terrestrial material through a process other than a grazing impact [e.g. 5]. In either case, dynamical models of Moon formation are in need of significant revision.

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Modelling tropospheric ozone concentrations over Ireland and North-east Atlantic

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Surface level ozone concentrations are very important in terms of air-quality, particularly during summer. Ozone levels over Ireland can be influenced by the transport of pollutants from other European regions and across the Atlantic from North America. High concentrations of ground level ozone can have harmful health effects on animals and plants. In this study, an attempt is made to investigate the spatial and temporal distribution of ozone over Europe and North-east Atlantic with a state-of-the-art Regional Climate Model (REMOTE) [1] with advanced atmospheric chemistry/aerosol dynamics modules and with appropriate meteorological and chemical boundary conditions. Additionally, a new detailed marine ozone deposition module has been included [2] in the model.



Figure 1: Monthly mean surface concentration of ozone ($\mu\text{g}/\text{m}^3$) for June 2003 with a horizontal resolution of 0.25° .

Simulation results are compared with both station and ozone sonde data for different periods. Qualitatively, the model is able to reproduce the observed values and trends.

[1] Langmann (2000) *Atmos. Environ.* **34**, 3585–3598.

[2] Coleman *et al.* (2010) *Advances in Meteorology* (submitted)