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THE NON-CARBONACEOUS NATURE OF EARTH'S LATE-STAGE ACCRETION

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Constraining the origin of Earth's building blocks requires knowledge of the isotopic characteristics of the source region(s) where these materials accreted. The siderophile elements Mo and Ru are well suited to investigating the mass-independent nucleosynthetic (i.e., "genetic") signatures of material that contributed to the late-stage of Earth's accretion (Moon-forming event onwards). The Mo and Ru genetics of meteorites distinguish non-carbonaceous (NC) from carbonaceous chondrite (CC) type materials, which may reflect formation in the inner and outer Solar System, respectively. The dominant share of moderately siderophile Mo was likely established in the bulk silicate Earth (BSE) during the final 10 to 20% of Earth's accretion. The highly siderophile Ru was likely predominantly added to the BSE following core formation, during the final 0.5 to 2% as late accretion. Studies contrasting the Mo and Ru isotopic compositions of the BSE to genetic signatures of meteorites, however, have reported conflicting estimates of the proportions of the NC and CC materials delivered to Earth during late-stage accretion. Some Mo isotope studies conclude that the genetics of the Moon-forming event was 50% NC:50% CC. By contrast, the Ru isotopic compositions of pre-3.65 Ga (Eoarchean) rocks that may sample an ancient mantle domain deficient in late-accreted Ru, suggest that materials added to the mantle prior to late accretion were dominantly NC. To constrain the proportions of NC and CC materials added to Earth during late-stage accretion, we report new mass-independent Mo isotopic data that are presumed to reflect the composition of the BSE and a range of NC iron meteorite compositions. Results indicate that the Moon-forming event was dominated by NC materials. This interpretation brings estimates of the genetic signatures of Mo and Ru for the BSE into concordance. If the common assumption that CC materials originated in the wetter, outer portion of the protoplanetary disk is correct, these observations also suggest that late-stage accretion was probably not a major supplier of water to the planet.