Nitrogen Isotope Anomalies in the Isheyevo Meteorite

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Nitrogen isotopic distributions in the solar system show a wide range from the Sun and Jupiter (delta ^{15}N = -400 permil), Earth (0 permil), Mars atmosphere (+600 permil) and comets (+900 permil) to organic matter in chondrites (> +1000 permil) [e.g. 1]. The cause of large variability of the nitrogen isotopic compositions is unclear either incompletely homogenized residual heterogeneities or solar system processes operating on an initially homogeneous reservoir because nitrogen has only 2 stable isotopes unlike oxygen. Stony-iron meteorites classified to CH/CB chondrites have high delta ^{15}N (+900 permil) whereas whole-rock nitrogen isotope measurements show stony meteorites and iron meteorites range in the Earth value [2-4]. The nitrogen careers have been investigated by in-situ isotope imaging techniques, but instrumental limitations prevent to clarify the essence [5-7]. In this study, we studied the Isheyevo CH/CB chondrite to understand the large nitrogen isotope variation using nitrogen isotope ratio mosaic maps obtained by an automated isotope microscope system. A polished thin section of the Isheyevo CH/CB chondrite was studied by FE-SEM-EDS for observation and an automated isotope microscope for nitrogen isotope ratio imaging. Several nitrogen isotopic anomalies were found including 5 to 20 micrometer sized nitrogen-rich material (-400 permil), silicates (+500 permil) and melted metals (+900 permil) in addition to sub-micrometer sized hotspots (> +1000 permil) in silicate clasts (+200 to +300 permil). Bulk solar system composition is clearly 14N-rich (delta ^{15}N = -407 permil) because of the Sun and Jupiter [8]. Fractionation mechanism needs some size and time like Mars or Titan. Organic matter cannot contribute to meteorite bulk because of the small size and low abundance even if it had extremely high delta ^{15}N value. Presolar origin is not suitable for current data [9]. The brecciated shock feature of CH/CB chondrite [10] may record the origin and explain the nitrogen isotope variability just like oxygen [11].

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