University of Colorado Boulder

ATOC/GEOG/GEOL/INSTAAR welcome you to the Joint Earth Seminar Series (JESS)

November 4th 2020 - 10:10AM MT

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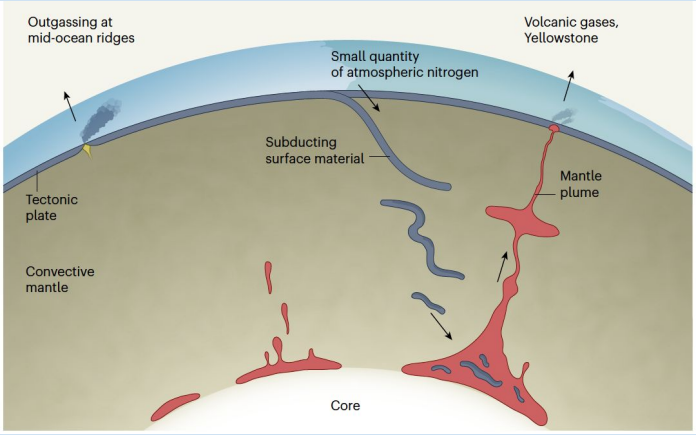
Abstract: Nitrogen is the main constituent of the Earth's atmosphere, but its provenance in the Earth's mantle is uncertain. Here, we constrain the origin of nitrogen in multiple mantle reservoirs and show that subduction may not be as important as previously thought to account for mantle nitrogen. We use the rare $^{15}N^{15}N$ isotopologue of N_2 as a novel tracer of air contamination in volcanic gas effusions. By correcting for air contributions in the gases using this tracer, we derive new estimates for mantle $\delta^{15}N$ and N_2-^3He ratios from multiple volcanic regions. We focus on Yellowstone, a primitive hotspot, and volcanoes from the central american subduction zone. One of the main results is that hydrothermal processes can cause deception. For instance, negative $\delta^{15}N$ values observed in gases, previously regarded as indicating a mantle origin for the nitrogen, in fact represent dominantly air-derived N_2 that experienced $^{15}N/^{14}N$ fractionation in hydrothermal systems. O_2/N_2 and N_2/Ar ratios are also fractionated by hydrothermal processes. In fact, fractionated air (rather than pristine air) is the major nitrogen contributor to hydrothermal gases. Using two-component mixing models to correct for the contribution of fractionated air, the $^{15}N^{15}N$ data allow unambiguous extrapolations that characterize mantle endmembers. We show that the subduction zone region has elevated $\delta^{15}N$ and $N_2/^3He$ relative to the convective mantle, consistent with slab nitrogen being added to mantle sources. In contrast, we find that while the Yellowstone plume has $\delta^{15}N$ substantially higher than the convective mantle, resembling surface components, it shows N_2-^3He ratios indistinguishable from the convective mantle. This observation is challenging to reconcile with significant nitrogen addition from the surface. Our $^{15}N^{15}N$-based analysis suggests that plume nitrogen may be a primitive component.

Title: **Hydrothermal $^{15}N^{15}N$ abundances: deception and clarity on the origins of planetary nitrogen**



Speaker: **Dr. Jabrane Labidi - *IPGP***

www.ipgp.fr/fr/labidi-jabrane

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