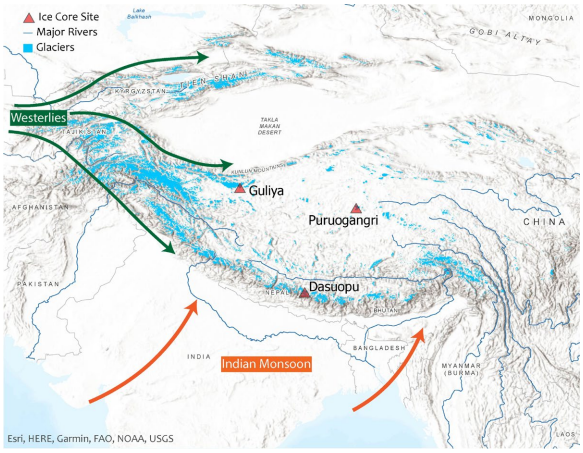
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Sources of Lead (Pb) in Asia since the Stone Age: Pb isotopic characterization of ice core samples from Tibet and the Himalayas

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Glaciers form through the accumulation of snow over centuries to millennia entrapping and preserving atmospheric aerosols that can be extracted from ice cores to study environmental changes. The Tibetan Plateau and Himalayan glaciers, among the world's most remote and pristine places, provide water to millions and play a vital environmental role. Known as the "Third Pole," they contain largest reservoir of fresh water outside the Arctic and Antarctica. Third Pole glaciers are of particular interest because the region has been substantially affected by anthropogenic emissions in the last decades.

To determine the sources of lead (Pb) and its spatio-temporal distribution in the Third Pole, we measured the lead isotopic composition (^{204}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb) in discrete ice cores samples from the Guliya ice cap in Northwestern Tibet, the Puruogangri ice cap in central Tibet, and the Dasuopu glacier in the Himalayas (see map below). Accurate isotopic measurements including that of ^{204}Pb allowed us to more sensitively quantify sources using the Bayesian mixing model MixSIAR.

Despite the dust-laden nature of the Guliya ice core, a clear shift in its Pb isotope signature away from Stone Age values begins in 1949, followed by a rapid change in 1960 and an even stronger shift in 1974, indicating the first emergence of anthropogenic lead. This pattern is consistent with other natural archives from eastern Tibet and occurs later than the onset of anthropogenic Pb in Europe and Greenland.

In contrast, the Dasuopu and Puruogangri ice core samples did not show a clear change in Pb isotope signatures, likely due to the limited number of samples that we analyzed from the post-1980s period, when anthropogenic Pb increased significantly. However, all three ice cores display distinct regional Pb-isotopic signatures. These findings and the application of the Bayesian mixing model MixSIAR will be discussed in this presentation.