Origin of natural gas-fed "eternal flames" in the Northern Appalachian Basin, USA

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Hydrocarbon gas seeps are surface expressions of petroleum seepage systems, whereby gas is ascending through faults and conduits from pressurized reservoirs that are typically associated with sandstones or limestones. The region around the states of New York and Pennsylvania marks the birthplace of commercial gas production from shales dating back into the 19th century. We sampled two burning seeps in New York and Pennsylvania that had not yet received geochemical scrutiny, including compound-specific stable isotope ratios of hydrogen and carbon. A spectacular "eternal flame" in Chestnut Ridge County Park (Erie County, western New York State) marks a natural gas macroseep of dominantly thermogenic origin emanating directly from deep shale source rocks, which makes this a rare case in contrast to most Petroleum Seepage Systems where gas derives from conventional reservoirs. The main flaming seep releases about 1 kg of methane per day and seems to feature the highest ethane and propane (C_2+C_3) concentration ever reported for a natural gas seep (~35 vol. %). The same gas is also released to the atmosphere through nearby invisible and diffuse seepages from the ground. The synopsis of our chemical and and stable isotope data with available gas-geochemical data of reservoir gases in the region and the stratigraphy of underlying shales suggests that the thermogenic gas originates from Upper Devonian shales without intermediation of a conventional reservoir. A similar investigation on a second "eternal flame" near Clarington in Pennsylvania suggests that gas is migrating from a conventional sandstone pool and that the seep is probably not natural but results from an undocumented and abandoned gas or oil well.

High-precision ^{10}Be-dating and Little Ice Age glacier advances at Steingletscher (Swiss Alps)

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The increase in sensitivity of the cosmogenic ^{10}Be technique now provides novel insights into glacier and climate change by giving dates throughout the Holocene and up to present day from moraines around the globe.

We show the first ^{10}Be chronology for Steingletscher in the Central Swiss Alps (47°N, ~2000 m altitude), consisting of 30 boulder ages. The chronology includes early Holocene glacier positions, which most likely reflect glacier responses to abrupt cold spells identified in other Northern Hemisphere paleoclimate records. On the younger inner moraines, fourteen ^{10}Be boulder ages from individual ridges are in stratigraphic order ranging from 170 to 530 years. We relate these boulder ages to glacier advances during the Little Ice Age (LIA, 14th to 19th century in the Swiss Alps). Two samples from moraine ridges inside the LIA limit of Steingletscher yield ages of 170 ± 10 years and 130 ± 10 years. These latter samples potentially allow for quantification of the amount of ^{10}Be inherited during prior periods of exposure, on the order of a thousand atoms per gram.

Our ^{10}Be data from boulders deposited during the last millennium are based on quartz samples as small as 5 g, facilitating routine processing for ^{10}Be dating even on such young samples. Comparing the Steingletscher data with other emerging ^{10}Be chronologies of recent glacier advances, we will discuss the current analytical limits of ^{10}Be dating together with the relevance of cosmogenic nuclide inheritance and other sources of natural uncertainty for the overall sensitivity of ^{10}Be surface exposure dating.

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