The Eh and pH of Fracking

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The extraction of natural gas from shale is now routine using massive slickwater hydraulic fractures. Along with its obvious economic advantages, this extraction technique comes with a number of well publicized risks, foremost of which is the migration of methane in the subsurface. Subsurface migration is a consequence of drilling into exhumed gas fields such as the Appalachian Basin where the areal extent of the Marcellus makes this gas reservoir one of the world's largest. During thermal maturation of the Marcellus between 300 Ma and 265 Ma gas was distributed throughout the Catskill Delta complex by natural hydraulic fractures (NHF). Migration of reducing fluids within redbeds of the delta complex accompanied NHF. Reduction halos allow the mapping of these pathways. While NHF was gas-driven as indicated by a cyclic plume pattern on fracture surfaces, high permeability NHF allowed the modern distribution of gas in these exhumed gas fields.

Peat land records of atmospheric mercury deposition in the French Pyrenees

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Abstract

Mercury (Hg) has a long residence time in the atmosphere, which suggests that Hg recorded in peat lands derives partly from long-range transport. However, Hg accumulation rates (Hg AR) reconstructed from peat cores in European bogs do not show exactly the same spatiotemporal evolution. The question remains to which extent local point sources, climate and site specific processes might influence Hg AR.

We present here results of three peat lands in the French Pyrenees: 1) Pinet (42°51'N, 1°58'E), 2) Orri de Théo (OT: 42°45'N, 1°24'E), and 3) Estibere (42°50'N, 0°10'E). The three sites cover a 150 km East-West transect along the French Pyrenees. The peat cores were cut at 1cm resolution according to the protocol of Le Roux *et al.* [1], Hg AR were determined for the last 2,000 years in OT and Estibere, and for the last 10,000 years for Pinet. A multi-coring protocol was used to investigate local-spatial variability of Hg AR. Pre-anthropogenic Hg AR obtained at Pinet show natural variations during the Holocene (between 0.2 and 13$\mu g.m^{-2}.y^{-1}$ with an average of 1.5$\mu g.m^{-2}.y^{-1}$), which could be related to climate change. Since the beginning of the Anthropocene, Hg AR increased by a factor 25 and are similar within and between the three peat lands.

In the upper part of the peat cores, three peaks are well-defined and recorded similarly at OT and Pinet, corresponding to the periods 1950-1955 (Hg AR at around 25$\mu g.m^{-2}.y^{-1}$ at OT and 42$\mu g.m^{-2}.y^{-1}$ at Pinet), the 1970's (38$\mu g.m^{-2}.y^{-1}$ at OT and 52$\mu g.m^{-2}.y^{-1}$ at Pinet) and 1994-95 (55$\mu g.m^{-2}.y^{-1}$ at OT and 62$\mu g.m^{-2}.y^{-1}$ at Pinet). The similar evolution of Hg AR in these two peat lands, which are spread out over 50km, suggest that they do not reflect Hg deposition from different local sources but more likely common regional or global source(s).

In addition to these similarities, we also observe some differences in Hg AR, reflecting local emission sources. For example, high Hg AR (around 12$\mu g.m^{-2}.y^{-1}$) are found around 1500AD at OT, probably the result of local Fe-Pb-Ag mining activities and related to coal burning, and a peak (100$\mu g.m^{-2}.y^{-1}$) is found at Pinet in 2001.

[1] Le Roux *et al.* (2010), *Mires and peat* **7**, 4.