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Noble gases in gas shales : Implications for gas retention and circulating fluids.

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Gas shales from three cores of Haynesville-Bossier formation have been analysed simultaneously for carbon, nitrogen and noble gases (He, Ne, Ar, Xe) to constrain their source compositions and identify signatures associated with high gas retention. Ten samples from varying depths of 11785 to 12223 feet from each core, retrieved from their centres, have been combusted from 200-1200°C in incremental steps of 100°C, using 5 – 10 mg of each sample.

Typically, Xe is released at 200°C and is largely adsorbed, observed in two of the three cores. The third core lacked any measureable Xe. High 40Ar/36Ar ratio up to 8000, is associated with peak release of nitrogen with distinctive isotopic signature, related to breakdown of clay minerals at 500°C. He and Ne are also mostly released at the same temperature step and predominantly hosted in the pore spaces of the organic matter associated with the clay. He may be produced from the uranium related to the organic matter. The enrichment factors of noble gases defined as (iX/36Ar)sample/(iX/36Ar)air where iX denotes any noble gas isotope, show Ne and Xe enrichment observed commonly in sedimentary rocks including shales (Podosek et al., 1980; Bernatowicz et al., 1984). This can be related to interaction of the shales with circulating fluids and diffusive separation of gases (Torgersen and Kennedy, 1999), implying the possibility of loss of gases from these shales. Interaction with circulating fluids (e.g. crustal fluids) have been further confirmed using 20Ne/N2, 36Ar/N2 and 4He/N2 ratios. Deviations of measured 4He/40Ar* (where 40Ar* represents radiogenic 40Ar after correcting for contribution from atmospheric Ar) from expected values has been used to monitor gas loss by degassing.

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