New insights into geologic CO_2 sequestration from natural analogues of the Colorado Plateau and Rocky Mountain provinces, USA

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Noble gas analysis permits the resolution of the lithospheric mantle contribution from both the crustal and groundwater-derived inputs within natural CO_2 reservoirs [1]. Determination of these crustal and groundwater sources provides new information about the role of the groundwater and the regional focussing and transport of magmatic CO_2 and other inorganic natural gases in the subsurface. Hence, the data presented here from SW US natural CO_2 fields provides an important analogue relevant to understanding the integrity of programs investigating the geological option for sequestration of anthropogenic CO_2.

We have extensivley studied CO_2 well gases from three systems to the east of the Colorado Plateau uplift province, and two systems from within the uplift area, namely Bravo Dome (Harding Co, NM) [1], Sheep Mountain (Huerfano Co, CO), McCallum Dome, (Jackson Co, CO), St Johns Dome (Apache Co, AZ) and McElmo Dome (Montezuma Co, CO). Our study is the first to determine a magmatic origin for the CO_2 in these fields, by comparing $\delta^{13}C(CO_2)$ and $CO_2/^3He$ ranges observed within the gas fields to those of MORB. Additionally, we have developed an innovative CO_2 redissolution model that can account for the clear reduction of the original magmatic $CO_2/^3He$ ratio and the fractionation of $\delta^{13}C(CO_2)$ isotopes obseved within all of the fields. This enables the processes responsible for lowering the $CO_2/^3He$ ratio, namely CO_2 dissolution into the groundwater and CO_2 precipitation as $CaCO_3$, to be distinguished and quantified. Importantly, this model highlights that in several of the reservoirs, precipitation of $CaCO_3$ is not a significant process in reducing the original $CO_2/^3He$ ratio compared to disolution of CO_2 into the groundwater.

References

[1] Ballentine et al. (2005) *Nature* **433,** 33-38.