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Experimental investigation into the geochemistry of produced fluids from hydraulic fracturing in the UK and USA.

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The safe and effective management of wastewaters from unconventional hydrocarbon production using the hydraulic fracturing process poses a major challenge.

Exploitation of unconventional hydrocarbons, such as shale gas, remains controversial across Europe due to concerns surrounding the fracturing process required to extract the resource. The key issue of how waste fluids produced by hydraulic fracturing across Europe will be safely managed has yet to be adequately addressed, mainly due to uncertainty over the composition of the waste waters that will be produced from the industry.

It is estimated that a single UK hydraulic fracturing operation will require between 7,000 and 18,000 m^3 of fluid, injected into the subsurface at pressures great enough to generate fractures, releasing hydrocarbons. Between 10 and 70 percent of this injected fluid returns to the surface on completion of the fracturing as wastewater. This waste requires appropriate management to ensure the need for fresh water is minimised, the efficiency and costs of the processes are maximised, and risks posed to the environment are reduced.

To address this knowledge gap we will present the results of novel experimental work undertaken to improve the understanding of chemical interactions taking place between fine grained hydrocarbon source rocks (shales from the UK and USA) and fracturing fluids in the subsurface during hydraulic fracturing. This work was undertaken as part of the EU Horizon 2020 Fracrisk Project (Grant No. 636811) which aims to characterise and quantify the risks posed to the environment during hydraulic fracturing across Europe.

The fracturing fluids, typically a mixture of fresh water, proppant, and chemical additives, react with the freshly fractured rock and mix with inherent pore water altering their composition. To better understand the nature of the chemical changes occurring in the subsurface during fracturing, a series of experimental batch reactions were undertaken.

Outcrop and core shale samples from the UK (Bowland Shale) and the USA (Marcellus Shale) were reacted with synthetic fracturing fluids at reservoir pressures and temperatures for periods of 7 - 28 days. These batch reactions provided insight into the geochemical progression of shale/fracturing fluid interactions in the subsurface. Our results improve our understanding of the characteristics of waste fluids produced at the surface following hydraulic fracturing.

Based on our experimental results, we make initial interpretation of the sources of the individual contaminants within produced fluid waste. These results improve our understanding of how rock characteristics and fracturing fluid composition affect the chemistry of waste fluids. This new knowledge will enable better preparation for the safe and cost effective treatment or disposal of such wastes in the UK and across Europe, helping to minimise the environmental risk posed by the produced waste.