This project investigated a statistical approach known as clustering to distinguish microseismic events induced by hydraulic fracturing (fracking) from the background microseismic events that occur every day.

When fluid is injected into the ground in hydraulic fracturing, it inevitably causes small movements in rock strata. These seismic event are normally small, but can sometimes provide early warning of further problems, such as reactivation of geological faults or damage to the well. However, similar small rock movements also occur naturally, so better methods to distinguish problematic fracking-induced seismicity from natural microseismic events could allow earlier detection of problems caused by fracking. Ultimately, real-time analysis of clustering of microseismic events could help to indicate the onset of fault reactivation and allow early intervention to prevent problems.

What did the project involve?
This project provided an initial assessment of the potential for clustering approaches in interpreting microseismic events. Criteria for defining a cluster were identified, using three-dimensional statistics and the establishment of threshold levels for assessing clusters.

Analysis was carried out using existing mathematical procedures. These were shown to be able to sort the seismic data and identify clusters. Initially, synthetic datasets were used to determine how the algorithms operated and their sensitivity in distinguishing clusters. These datasets had distributions that were close approximations to those expected during shale gas activities. The tools were then tested on real microseismic monitoring data from coal mines and from hydraulic fracturing in the USA.

What were the findings?
Careful selection of algorithm parameters meant that this approach could be used to detect and cluster outlier events (the events that may signify unusual seismic activity) as long as the events were more than around 450 m from the main seismicity cluster. This suggests that the method is promising and it may be worth carrying out further work both to develop bespoke software for easier analysis, and to test the effectiveness of clustering methods as early indicators of problems in fracking operations.

What is the next step?
To use the technique on a preliminary basis and to use any findings from this to develop the technique such that it could be used more routinely.

This summary relates to information from project SC170012 reported in detail in the following output(s):

Report: SC170012
Title: Guidance on seismic cluster identification and definition

October 2019

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This project was funded by the Environment Agency’s Research, Analysis and Evaluation group, which provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible.

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