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Mapping of structures formed by hydraulic fracturing based on microseismic events location.

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Structures created by hydraulic fracturing can be identified using the location of induced microseismic events. Estimating the effectiveness of stimulation depends on fracture mapping. Event location errors make precise imaging of fractures in a scattered seismic cloud challenging. In order to increase the reliability of the determined structures on the basis of events with location error, we proposed a several-stage procedure. This procedure was demonstrated on microseismic events located during the fracturing of the Wysin-2H/2Hbis horizontal well, an exploration well for shale gas in northern Poland from June 9, 2016 to June 18, 2016. All located events were subjected to a collapsing that allows obtaining new locations of events that are equivalent to original locations in a statistical sense. The creation of such an equivalent point cloud allows us to see certain structures that may reflect, for example, fractures. To validate the results before and after collapsing method, all events were set against the probability of a given brittleness index map. It is demonstrated that the collapsed events occurred in regions that were more rigid, while the locations of events prior to this procedure showed no relationship with the occurrence of areas with higher susceptibility to fracking. The unsupervised machine learning algorithm HDBSCAN was used on a collapsed cloud to automatically detect clusters of events. The directions of identified clusters agree with the direction of regional maximum horizontal stress.