

## **On the possibility of magnetic nano-markers use for hydraulic fracturing in shale gas mining**

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### **Abstract**

Recently shale gas production became essential for the global economy, thanks to fast advances in shale fracturing technology. Shale gas extraction can be achieved by drilling techniques coupled with hydraulic fracturing. Further increasing of shale gas production is possible by improving the efficiency of hydraulic fracturing and assessing the spatial distribution of fractures in shale deposits. The latter can be achieved by adding magnetic markers to fracturing fluid or directly to proppant, which keeps the fracture pathways open. After that, the range of hydraulic fracturing can be assessed by measurement of vertical and horizontal component of earth's magnetic field before and after fracturing. The difference in these components caused by the presence of magnetic marker particles may allow to delineate spatial distribution of fractures.

Due to the fact, that subterranean geological formations may contain minerals with significant magnetic properties, it is important to provide to the markers excellent magnetic properties which should be also, independent of harsh chemical and geological conditions. On the other hand it is of great significance to produce magnetic markers at an affordable price because of the large quantities of fracturing fluids or proppants used during shale fracturing.

Examining the properties of nano-materials, it was found, that they possess clearly superior magnetic properties, as compared to the same structure but having a larger particle size. It should be then possible, to use lower amount of magnetic marker, to obtain the same effect.

Although a research on properties of new magnetic nano-materials is very intensive, cheap magnetic nano-materials are not yet produced on a scale appropriate for shale gas mining.

In this work we overview, in detail, geological, technological and economic aspects of using magnetic nano-markers in shale gas mining.

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