A Real-Time Method to Identify Brittle Zones in Carbonate-Rich Shales Using Bulk and Trace Element Geochemistry: A Study in the Eagle Ford and Haynesville Formations

Michael Fonseca, Lori Hathon, Thomas Lapen
University of Houston

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

With advancements in technology such as horizontal drilling and hydraulic fracking, operators are able to pursue reserves in unconventional mudrock reservoirs. Brittleness, one of the many pre-screening considerations, is an important parameter because it determines whether a mudrock can be effectively stimulated via hydraulic fracking. The industry currently uses several geochemical signals (e.g. Si/Al and Si/Zr) to identify authigenic silica phases present in a reservoir. Cemented horizons are prime candidates for placing hydraulic fracks due to the strengthening effects of mineral cements on the rock frame. A similar geochemical method for readily indicating the occurrence of authigenic carbonate has not been identified. This study documents trace element geochemical differences between detrital carbonate phases and associated cements so that chemical proxies may be used to identify authigenic carbonate using bulk geochemical data. We are studying both carbonate rich formations (e.g. Eagle Ford and Niobrara) and argillaceous formations (e.g. Haynesville and Marcellus) to gain insight into reservoir brittleness, using bulk and trace elements such as Ba, Mg, Mn, Fe, Sr, and Ca. The goal is to develop a technique that can be implemented real-time by the mudlogging unit at the wellsite and during the initial core analysis phase. This method will allow a more targeted placement of hydraulic fracking zones to increase permeability and hydrocarbon production in mudrock reservoirs. Electron probe micro

analysis (EPMA) on several generations of carbonate, from biogenic to authigenic, was conducted on low (0.45 %R_o) and high (2.5 %R_o) thermal maturity Eagle Ford and Haynesville Formation samples, respectively. The EPMA reveals that Sr is the primary elemental signature of the authigenic carbonate phase within the low maturity Eagle Ford. The Haynesville EPMA reveals higher variability of Fe, Mn, Sr, Mg, and Ba trace element concentrations, however the dominant elemental signature associated with the authigenic phases is elevated concentrations of Fe and Mn. Utilizing XRF, a Sr/Ca and Fe/Mg trend can be used as a proxy for authigenic carbonate in the Eagle Ford and Haynesville respectively, and can be used to assess brittle zones for target adjustments at the wellsite.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.