

New Insight into the Organic Matter Accumulation of Shale Formations in the Southern Sichuan Basin, Implications from the Volcanic Activities

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Abstract

The Wufeng-Longmaxi Formations (WF-LM) in Sichuan Basin is a set of graptolite-bearing shale strata containing high frequency bentonite layers. In order to investigate the influence of volcanic activities on the organic matter (OM) accumulation in shale formations, detailed observations of several typical profiles and wells were performed. Then analyses including total organic carbon (TOC) contents, mineral compositions, major and trace elements were conducted on 25 shale and 5 bentonite core samples from WF-LM in well Lu-A. Results shows that, WF and LM1-4 formations are the bentonite beds concentrated section, while few bentonite layers are found in LM5-6 and none is found in LM7-9. The bentonite layers contain high K content and have typical characteristics of intermediate-acidic volcanic rocks such as andesite and dacite. It is probably originated from intraplate collision or volcanic arc structural backgrounds, which are related to the collision and subduction of Yangtze plate and the Cathaysia plate. Productivity indicators including P content, Si, P/Ti, Cu/Al, Ni/Al, and Ti/Al in the WF formation and LM1-3 sub-members are significantly larger than those in the LX formation and LM4-5+ sub-members. The higher biological productivity proxies during Ordovician-Silurian (O-S) transition are attributed to the multi-period volcanic activities, which bring massive biologically relevant nutrient elements and thus promoted phytoplankton blooms. All the redox condition indexes (MoEF, UEF, U/Th, Ni/Co and V/Cr) positively correlate with TOC content. During O-S transition, the

intense and frequency of volcanic eruptions and sea level changes lead to periodical anoxic conditions and toxic substances releasing, which subsequently result in large-scale and instantaneous death of plankton. In addition, the deposited bentonite layers have strong ability of oxygen isolation. Our study will not only help understanding the relationship between volcanism and OM enrichment mechanism, but also provide a new model to illustrate OM accumulation in the organic-rich shale formations in Southern Sichuan Basin.