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Vanadium Enrichment in Silurian Black Shales of SE Sardinia (Italy): Comparison with Other Cases of Northern Gondwana

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Vanadium is currently considered a critical metal (CM) for both the European Union and the United States. Black shale-hosted vanadium deposits account for about 80% of vanadium resources in the world, but only <2% V can be considered economic. The average Paleozoic black shales contain values of about 400 ppm of $\Sigma\text{Mo}+\text{Ni}+\text{Zn}+\text{Se}+\text{V}$, as well as 2–10% organic carbon.

In the Silurian of North Gondwana, significant black shale successions were deposited in a series of basins under strong anoxic conditions. These successions have a variable content of organic matter and metallic elements. Their vanadium amount ranges from subeconomic values (Northern Bavaria, Germany: 9,500 ppm V) to only scientifically significant concentrations (Turkey: up to 400 ppm V; Carnian Alps: 250-500 ppm V). Silurian black shales, still poorly investigated for V, are also present in several areas of Northern Africa, as in Lybia and Morocco.

Slightly metamorphosed Silurian black shales in SE Sardinia (Italy) have many paleontological, mineralogical, and geochemical similarities with other coeval successions of northern Gondwana. We detected a content in C/org ranging from 2.15 to 10.00%, as well as anomalous values of Fe, Ba, F, Pb, Zn, Cu, and Mo. Their amount in vanadium is fairly variable, ranging from 250 to 2,300 ppm V. Our preliminary data show that V is mainly contained in rutile and illite/muscovite. Both these minerals are associated with (sub-)greenschist facies metamorphism (SE Sardinia “External Nappes”); V may have been released from organic matter during metamorphism and incorporated in both phases. However, because mass balance calculations are insufficient to fully explain the V enrichment in rutile and fillosilicates, it is possible that organic matter has retained at least part of the V.

Mineralogical and geochemical research on V in Black Shales will be extended also to coeval shales in northern Africa.