NATIVE SULFUR CRYSTALS FROM THE BADLANDS, SOUTH DAKOTA

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ABSTRACT

Authigenic native sulfur crystals exhibiting a well-developed bipyramid modified by the basal pinacoid have been recovered from the Tertiary sediments of the South Dakota Big Badlands. These crystals were present in a channel sandstone, occurring singly and coating allogenic quartz sand grains. Other authentic minerals from this location include gypsum, jarosite, limonite, and ferrimolybdite.

INTRODUCTION

As part of a study of the systematic mineralogy of the Black Hills and surrounding region, samples of the channel standstones of the Oligocene Chadron Formation were collected to investigate the occurrences of secondary uranium minerals. A number of secondary minerals including uranocircite, a barium uranyl phosphate, have been reported (Moore and Levish, 1955) from the Tertiary sandstones of the White River Badlands.

The samples were collected from the area near the south scarp of Hart Table in the NE ¼ of section 36, T. 3S., R. 12 E,. in Pennington County. The mineralized channel sands occur near the base of the Chadron Formation just above the contact with the Cretaceous Pierre Shale.

MINERALOGY AND GEOCHEMISTRY

X-ray powder diffraction, optical, and chemical analyses were run on prepared portions of these samples. An unexpected high percentage of molybdenum was found in the chemical analyses. X-ray powder diffraction data showed this to be due to the occurrence of the mineral ferrimolybdite, a hydrated molybdate.

Native sulfur crystals ranging up to 0.4 mm. in size were separated optically from a number of the samples and positive identification was made by X-ray powder diffraction analysis and a melting point determination. These crystals exhibited a perfectly-developed bipyramid (p) modified by a basal pinacoid (c) (see figure 1.). Crystals showing only a small development of the basal pinacoid were the most common. These forms are the ones typically found on sulfur crystals.

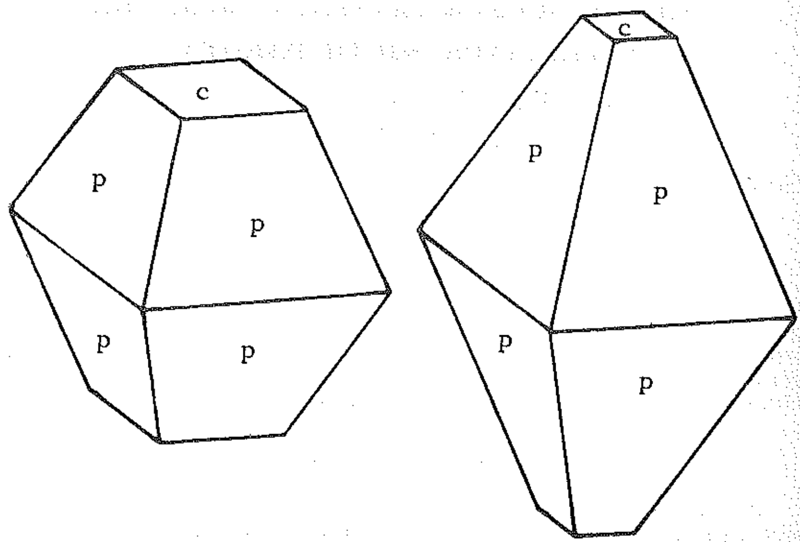

Figure 1. Orthographic crystal drawings from stereographic projection showing the habit of the native sulfur crystals from the Badlands. The two drawings illustrate the difference in appearance caused by a difference in the extent of the development of the basal pinacoid (c) which modifies the orthorhombic bipyramid (p).

The sandstone of these deposits was either red, indicative of hematite, or a yellow brown caused by the occurrence of limonite and jarosite. The sulfur crystals were most prominent in the red hematitic portion of the sandstone.

The complete authigenic assemblage found in the host channel sandstone samples collected was: sulfur, ferrimolybdite, jarosite, gypsum and limonite. No uranium minerals were found. Jarosite and gypsum are sulfates with the sulfur in the plus-six oxidation state. Jarosite and limonite are common and widespread secondary minerals that occur in the near-surface oxidized portions of the earth's crust.

Native sulfur on the other hand is frequently associated with volcanic activity. It occurs as a product of the gases given off at fumaroles and hot springs. Sulfur may also be formed by the action of sulfur bacteria on sulfates. The sulfur found in the Tertiary sedimentary rocks and salt domes where it is associated with gypsum is probably the result of the separation of sulfur from the gypsum. However, in the Tertiary sediments from the

Badlands the sulfur and gypsum occur as authigenic partners. Distinctly different and seemingly geochemically incompatible mechanisms are required for the authigenic formation of native sulfur versus sulfate minerals.

CONCLUSIONS

A possible mechanism for the formation of the sulfur is the decomposition of hydrogen sulfide generated by decaying organic material. However, the associated molybdenum and uranium minerals strengthen the possibility of hydrothermal mineralization: Moore and Levish (1955) favor downward moving ground water containing uranium leached from overlying volcanic ash as the source of the uranium mineralization.

REFERENCE

Moore, George W., and Levish, Murray (1955), Uranium-bearing sandstone in the White River Badlands, Pennington County, South Dakota: U.S. Geological Survey Circular 359.