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FLUORSPAR IN SILICIFIED ROCKS IN NEW MEXICO

by W. N. McAnulty, Sr.

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The main purpose of this series is the immediate release of significant new exploratory information which otherwise would have to await release at a much later date as part of a comprehensive and formal document. These data are preliminary in scope, therefore, subject to revision and correction.

Socorro, 1972

INTRODUCTION

More than 200 occurrences of fluorite (CaF_2) are known in 12 counties in New Mexico; approximately 650,000 tons of fluorspar, an aggregate of rock and mineral matter containing enough fluorite to make a commercial deposit, have been mined from 91 deposits in 11 counties. Most of the fluorspar produced came from relatively narrow veins enclosed in a wide variety of sedimentary and igneous rocks. Most of the fluorite in these veins was precipitated from hydrothermal fluids emanating from magma chambers at depth, filling or partially filling open spaces available in fractures along faults, joints, and shear zones. Commonly the fluorite cemented rock fragments (fault breccia) formed along active faults before the fluorine-bearing fluids were introduced. Some of the fluorite, usually only a minor part of the total amount present, was formed by replacement of fault breccias and wall rocks. Open-space, void-filling, or precipitated fluorite is commonly medium-to coarse-grained and relatively pure, whereas replacement fluorite is finer grained and often impure. However, vein material of a mineable thickness generally includes varying amounts of calcite, quartz, iron oxides, unreplaced rock and other impurities which lower the grade of the fluorspar. Few deposits yield commercial ore without some form of beneficiation.

Fluorspar is marketed in three grades--metallurgical, ceramic, and acid. Metallurgical grades, used chiefly in steelmaking, specify a certain number of effective units of CaF_2 calculated by subtracting $2\frac{1}{2}$ times the percentage of silica (SiO_2) from the percentage of CaF_2 in the ore or concentrate. For example, an ore or concentrate assaying 85 percent CaF_2 and 5 percent SiO_2 contains $72\frac{1}{2}$ percent effective CaF_2 . Ceramic and acid grades are expressed in percentage of CaF_2 . Ceramic grades range from 85 to 96 percent CaF_2 . Acid grade, used chiefly in the aluminum and chemical industries, must contain 97 percent or more CaF_2 . Some consumers place rigid restrictions on the amount and kind of impurities in ceramic and acid grades.

Because silica (SiO_2), chalcedony, and other fine-grained varieties of the quartz family of minerals is particularly undesirable in fluorspar, many deposits with a high silica content were not commercial in the past. Therefore, little or no attention was given to such deposits in prospecting. In fact, prospectors steered away from them. Most metallurgical uses require fluorspar in lump form, and a concentrate cannot be used unless it is pelletized. Silica is a common impurity in fluorspar deposits; few deposits yield metallurgical grade without selective mining; little or no metallurgical ore can be produced profitably from most deposits without concentrating and pelletizing.

Producing a salable product from most fluorspar deposits requires processing by heavy media (sink-float) or froth flotation, or both; and large capital expenditures are required for the beneficiation plants. Large reserves are required if the costs are to be amortized--at least ~~one million tons~~ for a medium-sized plant. Obviously, with a total production of only about 650,000 tons from 91 different deposits in New Mexico, the known fissure vein deposits within the state are small. Few fissure vein deposits contain large reserves anywhere. However, many large, low-grade, siliceous deposits in New Mexico could be developed and profitably exploited. The purpose of this paper is to direct attention to these deposits.

SILICIFICATION

Metallic and nonmetallic ore minerals are often found where silica (SiO_2) has replaced the original substance comprising the rock--a process called *silicification*. Silicification is a common form of hydrothermal alteration because silica is a common constituent of warm or hot ore-bearing fluids. All rock types are susceptible to some degree to replacement by silica; the carbonate rocks, limestone and dolomite, are particularly susceptible.

The silicification of limestones and dolomites produces *jasperoid*--a rock consisting essentially of very fine-grained quartz or chalcedony or opal formed by the replacement of some other material, ordinarily calcite or dolomite. In some "jasperized" districts the rocks were first hardened by the addition of fine-grained silica and were later brecciated or broken by faulting. Brecciation of the brittle silicified rocks opens relatively continuous zones for circulating fluids. The presence of jasperoid, and silicification in general, is evidence of intense action by mineral-bearing solutions; and always deserves careful prospecting. Silicification is common in limestones, dolomites, shales, and along faults and shear zones in any kind of rock.

CHARACTERISTICS OF FLUORSPAR DEPOSITS IN SILICIFIED ROCKS

The physical characteristics of the silicified host rocks, and the enclosed fluorite, are essentially the same for jasperoid and for jasperized (or silicified) igneous rocks. Rocks in the silicified zones are almost completely replaced with fine-grained silica. Irregular-shaped vugs, formed as a result of replacement, are scattered throughout the rock. These vugs, along with fractures and spaces between broken silicified rock (breccia) produced by movement after the initial silicification, may be lined, filled, or partially filled with medium-to coarse-grained fluorite and/or a later generation of quartz. In some places, a small amount of fine-grained replacement fluorite is disseminated in the fine-grained siliceous matrix.

Fluorite is not likely to be uniformly distributed throughout the silicified rock; in fact, its distribution is usually very erratic. Irregular pods may contain a few hundred tons of fluorspar with more than 50 percent CaF_2 . More commonly, however, the richer concentrations contain less than one ton. Sizeable areas surrounding the pods often contain little or no visible fluorite. The tonnage in the higher grade concentrations is not likely to be enough to support a successful mining venture; selective mining would not be profitable. All of the fluorite-bearing silicified rocks will have to be mined and processed. Determining the average grade will be difficult, and cannot be done by analyzing chip or channel samples cut from a few outcrops, or by analyzing drill cuttings obtained by air-percussion drilling. Blending of sizeable bulk samples taken from several places and averaging several analyses of the thoroughly mixed bulk sample offers the best method of ascertaining a reliable grade figure.

Jasperoid fluorspar deposits now being mined in the Winkler Anticline in Hidalgo County appear to be similar to jasperoid and jasperized occurrences known at several other places in New Mexico. Bulk samples of this ore averaged 33.42 percent CaF_2 .

Known Occurrences of Fluorspar in Silicified Rocks in New Mexico

Most of the known fluorspar-bearing jasperoid occurrences are in limestones and dolomites of Pennsylvanian and Permian ages. The Magdalena Group (Pennsylvanian) is the host at places in the Caballo Mountains, near Chise in the Cuchillo Mountains, and on the Chavez Ranch west of Truth or Consequences. The Horquilla Limestone (Permian) is the principal host in the Winkler Anticline, Animas Mountains, and the Yeso Formation contains fluorite-bearing jasperoid on Radar Hill, on the east slope of the Caballo Mountains. However, the El Paso Limestone (Ordovician) is the host in the area of the Anniversary claims in the Florida Mountains; Cretaceous limestones also contain fluoritized jasperoid in the area of the Winkler Anticline. All Paleozoic and Cretaceous limestone and dolomite are possible host rocks, therefore, all outcrops of these rocks deserve attention.

Possible commercial deposits of fluorspar in jasperoid are known in: Winkler Anticline, Animas Mountains, Hidalgo County; on the east slope of the Caballo Mountains, Sierra County; near Chise, in Cuchillo Mountains, Sierra County; on the Esquipula Chavez Ranch, 22 miles west of Truth or Consequences, Sierra County; in the northern part of Fluorite Ridge and in Goat

Ridge, Luna County; and Bishop Cap, Doña Ana County. Doubtless, further prospecting will discover other occurrences.

Possible commercial deposits in jasperized igneous rocks are known in the Bitter Creek Area, Grant County; in an area 5 to 7 miles north of Cook's Peak (old White Eagle and Linda Vista claims), Grant County; and in Whitewater and Holt Canyons (old Huckleberry and Lone Star claims), Catron County. Almost certainly other occurrences of this type exist in volcanic terranes at many places in New Mexico.

PROSPECTING FOR FLUORSPAR IN SILICIFIED ROCKS

Silicified rocks in New Mexico are a potential source of large low-grade fluor spar reserves. Prospectors searching for fluor spar should carefully look at all silicified outcrops, whether they be in the form of dikes, sills, knobs, cappings or irregular-shaped patches. Particular attention should be given to silicified outcrops exhibiting brecciation and vuggy structures. Silicification is widespread in New Mexico and recent work in widely separated districts has revealed that fluor spar is commonly present in silicified rocks.

Silicified zones usually are more resistant to weathering than surrounding, non-silicified rocks and are, therefore, easy to see in the field because they stand above their surroundings. The fine-grained quartz or chalcedony weathers to a hard, smooth surface on which fluor spar is very difficult to see, even though it may be fairly abundant in the rock.

Fluorite is much softer and weathers more readily than quartz or fine-grained silicified (jasperoid) rock; also fluorite cleaves easily. Therefore, it is not conspicuous on weathered surfaces of silicified rock. However, once the prospector becomes familiar with silicified outcrops, he may see some fluorite on hard, slick silicified surfaces. But in places where fluorite cannot be seen on the surface, it may be easily seen on a freshly broken piece of rock a fraction of an inch beneath the weathered surface. Break the rocks! Look for thin seams along fractures; look at the cementing material filling the space around angular fragments; look at the material lining or filling vugs. Outcrops of silicified, fluorite-bearing material often are iron-stained and have crumbly surfaces. Fluorite has cleavage, whereas, quartz or chalcedony does not. Check all minerals which have cleavage. Fluorite can be distinguished from calcite or other carbonate minerals by use of a drop of dilute hydrochloric acid. The carbonate mineral effervesces in the acid, whereas fluorite does not.