To: John Schilling

From: Keith G. Papke

Subject: Sulfur deposits in Nevada

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Introduction

As you requested I have visited the principal areas where sulfur occurs in Nevada. The following description tells of the current status of these deposits, their geology, and their probable economic potential. I have included in the introductory portion some information on the reasons for the current interest in sulfur.

Interest in sulfur deposits in Nevada probably is at an all-time high. This is a reflection of the current free world supply and demand situation. For three years demand has exceeded production and excess orders have been filled from stockpiles (private stockpiles; sulfur is not a government stockpile commodity). Demand for sulfur continues to grow at a rate of 6 to 7 percent a year. In 1965 free world production of all forms was 22,800,000 long tons. Recent estimates are for a consumption in excess of 30,000,000 long tons in 1970.

The fertilizer industry is the largest consumer. In 1965 the domestic phosphate industry used 6,700,000 long tons in the acidulation of phosphate rock with sulfuric acid. The most promising substitution in this industry is by nitric acid but this gives a more expensive and less suitable product. Sulfuric acid will probably be used as long as supply and price permit.

Sulfur to meet this demand will have to come mostly from reactivated and new Frash process installations along the Gulf of Mexico. The limitation of exports from Mexico to a percentage of newly-found reserves further complicates the situation. There will be increased yield from sour gas fields but the additional tonnage will be relatively small. Sulfur produced from deposits of the type found in Nevada and California will never be an important factor in supply. It is obvious that there will be abnormal interest in sulfur deposits until 1970 at least.

The shortage has caused a price increase but the amount is uncertain because quotations commonly give only nominal figures. Domestic bright sulfur has been quoted at $27 since 1964. In September of 1966 the E. and M. J. Metal Market, while still retaining this quotation, also quoted $39 f.o.b. Gulf ports for export and stated that the current spot market is about $42 f.o.b. mine.

Nevada Sulfur Deposits

The following is a summary of Nevada sulfur deposits, in north-to-south order of location.

1) Sulphur district, Humboldt County. This district is along the northwest edge of the Kamma Mountains, principally in Sections 35 and 36, T. 35 N., R. 29 E. The Western Pacific railroad goes through the settlement of Sulphur several miles northwest of the area. The patented claims that cover this area are optioned to Canyon State Mining Company and/or Pacific Sulphur Company. One or both of these companies is a subsidiary of Great American Industries, a New York based firm.

The main part of the district has an exposed length of about 6,500 feet and an average width of about 1,800 feet, with a north-northeast trend. This is expressed topographically, with the sulfur district situated on an irregular, hilly terrace. This terrace is bounded on the west by a bluff that extends down to the valley floor, and is bounded on the east by another bluff that leads to the higher mountains farther east. There is evidence that the bluffs actually are fault scarps.

The rocks exposed on this terrace are water-lain sediments of Tertiary age. The predominant rock is a well-cemented conglomerate but some sandstones probably are present in the southwestern part. Generally the rocks dip eastward at low angles. The bluffs are composed of resistant, partly opalized and silicified conglomerates. Alteration within the confines of the terrace is variable. Most of the area is underlain by a light-colored - or locally red stained - friable, siliceous material; in the strongest altered places an occasional unaltered pebble is the only evidence of the original character of the rock.

Sulfur has been mined from about a dozen pits. These range in size from one about 250 by 150 feet (the Mercury pit) to some less than 50 feet in diameter. Outside the pit areas there is only occasionally any evidence of sulfur mineralization. Structural control of the mineralization is not apparent although north-northeasterly trending faults or fissures may have exercised some influence.

The sulfur occurs as disseminated grains, preferential replacement of the conglomerate matrix, irregular veins and masses and coatings on fracture surfaces. The average grade of material mined in the past is said to have been 15 to 38 percent. The most abundant accompanying materials are silica minerals, alunite and some gypsum. Mercury is present in some of the material; conceivably it could be a by-product. Some silver mineralization is present along the western bluff at the south end but there is no sulfur in this area.

There are several other sulfur occurrences outside the area discussed above. The most important of these is the Peterson pit area about one mile to the northeast but still within the claim group. Sulfur occurs as fairly high-grade material along a north-northeast fault zone (parallel to the faults mentioned above) that brings conglomerate on the west down against older volcanic rocks. This area and the Mercury pit have the best sulfur reserves seen on the property.

Drilling was started this April. It was stopped early in October but apparently is to start again. I estimate that 150 rotary holes have been drilled; these are irregularly spaced throughout the altered area but have a denser distribution in the old pit areas. The maximum depth observed was 300 feet but the average depth was less than 100 feet. Examination of the cutting piles from many holes showed a surprising lack of sulfur in much of the area. With few exceptions only holes in or close to the old pits seemed to have encountered much sulfur and then generally only in the upper part of the holes.

Evaluation of the potential of this district is difficult without a detailed analysis of drill hole results. Almost certainly this district will never be a major source of sulfur, particularly if one is referring to pure, bright sulfur. However, in view of the area size and the number of pits it

is not impossible that several million tons with grade in the order of 30 percent might be developed. Certainly this district has the best sulfur potential of any in Nevada.

Conclusion

Examination of Nevada sulfur deposits as a group has led to some conclusions.

1) There is no present production of sulfur and the possibility of finding large tonnages amenable to production of pure sulfur are poor.

2) Directly mined, high-grade ore - say over 70 percent - could be available in only small tonnages.

3) There is a better possibility of producing limited tonnages of sulfur rock for agricultural use. In relation to percentage of total sulfur, it might be advantageous from a price standpoint to produce agricultural sulfur.

4) Based on the evidence now available, I rate the properties in the following order of potential economic significance: a) Sulphur; b) Alum; c) Deep Gulch; d) Hot Springs Point; e) San Emidio; f) Tognoni; g) Humboldt; and h) Cuprite.

5) By-product material might enhance the value of some ores. This is particularly true of mercury. Cinnabar is known to be present in significant quantities at the Sulphur and San Emidio properties.

6) Transportation must be considered in property evaluation. The Sulphur, Hot Springs Point and Humboldt areas are well situated near railroads, but the others are poorly situated at distances of 45 miles or more from railroads. Soil conditioner, mainly for a central California market, might not be dependant upon railroad location; it might be better transported by truck.