THE GEOLOGICAL SURVEY OF WYOMING
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OPEN FILE REPORT 90-2

RUTILE IN WYOMING

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Laramie, Wyoming
1990

This report has not been reviewed for conformity with the editorial standards of the Geological Survey of Wyoming.

Contents

Introduction

Rutile (TiO_2) is an industrial mineral used as a source of titanium dioxide pigments. (Ilmenite ($FeO \cdot TiO_2$) is another source of titanium dioxide pigment.) Rutile is the high-pressure and high-temperature polymorph of TiO_2. The other polymorphs are anatase and brookite. It is the most common polymorph, and is usually found as an accessory mineral in high-grade metamorphic and igneous rocks. Ilmenite or anatase may alter to rutile, which is a very stable mineral, but occasionally rutile alters to sphene, sometimes to ilmenite, and rarely to anatase (Lynd and LeFond, 1983).

Production and economic uses of rutile

Rutile is mined from both sand and hard-rock deposits. Rutile sand deposits are found primarily in modern or ancient beach placer deposits, where the heavy titanium-rich minerals are concentrated by gravity through the action of waves. Some of these beach sand concentrates contain up to 80 percent heavy minerals; the proportion of rutile varies depending upon the rock types in the source area of the sand.

Most of the commercially important hard-rock sources of rutile are associated with gabbro or anorthosite. (See Harris, 1990, for a summary of anorthosite and the Laramie Mountains Anorthosite, Wyoming.) Ilmenite-rutile deposits are found in gabbro or anorthosite, either together or as separate concentrations (Lynd and LeFond, 1983). In the United States, a peralkaline pegmatite at Magnet Cove, Arkansas, contains rutile and the polymorphs anatase and brookite (Fryklund and Holbrook, 1950). Porphyry copper deposits contain rutile, and the tailings produced after the extraction of copper and other by products have been investigated as a commercial source of rutile. There is a large volume of rutile available in the tailings from western U.S. copper deposits, but the low grade (0.3%) is not economical to process at the present time (Llewellyn and Sullivan, 1980).

There are two major producing rutile deposits in the U. S. At Roseland, Virginia, rutile in border facies of anorthosite and the enclosing gneiss and in dikes is concentrated in a saprolite weathering horizon. This mine has operated since 1900. The other major producing deposit is a peralkaline pegmatite at Magnet Cove, Arkansas (Lynd and LeFond, 1983).

To produce pigment, natural rutile is first converted to titanium tetrachloride ($TiCl_4$) by heating the raw material with oxygen and chlorine at 850°C to 900°C in the presence of petroleum coke. The purified titanium tetrachloride is then converted to titanium dioxide by oxidizing the tetrachloride at a high temperature. The dioxide is then calcined at about 500°C to 600°C to remove any residual chlorine or chlorine compound. Chlorine used in this process is recycled. The cost per ton of pigment manufactured by this chlorine process is less than the cost per ton using the sulfate process to treat ilmenite ore (Lynd and LeFond, 1983).

Titanium dioxide pigment was produced in 1988 by five companies in eleven plants in the United States. The total value of U. S. production was $1.8 billion. The pigment was used in paint and related products (50%), paper (24%), plastics (17%), rubber (2%), and others (7%) (Lynd, 1989). The production of titanium dioxide has been increasing over the past five years, and the price of rutile has also been increasing (**Table 1**). Production is expected to increase. Four U. S. producers are planning plant expansions, and one new plant is under construction (Lynd, 1989).

Table 1. Production and price of titanium dioxide, 1984 to 1988.

Titanium dioxide[1]	1984	1985	1986	1987	1988
Production[2]	834,889	863,543	930,653	951,685	1,020,000
Price of rutile[3]	0.75	0.78	0.81	0.81	0.92

[1]After Lynd (1989)
[2]short tons
[3]dollars per pound at the end of the year listed

Rutile occurrences in Wyoming

Rutile is found in Wyoming in both igneous rocks and Cretaceous paleobeach placer deposits. The following is a list of known rutile occurrences in Wyoming,

Wyoming, segregated by the type of occurrence. There are no identified rutile occurrences in Wyoming with economic potential.

Igneous occurrences of rutile

(Numbers refer to localities, **Figure 1**).

Albany and Platte Counties

1) Laramie Mountains Anorthosite (T.16-21N, R.71-72W. and the W1/2 of Ts. 20 and 21N, R.70W.

Rutile is found in small amounts associated with titaniferous magnetite deposits in the Laramie Mountains Anorthosite. (Hagner, 1968).

Carbon County

2) East end of the Seminoe Mountains

Aughey (1886), reported an occurrence of rutile in this area near the North Platte River. One specimen was found. There have been no subsequent reports of rutile in this area.

Sweetwater County

3) Steamboat Mountain, Leucite Hills secs. 9, 10, 15, and 16, T.23N, R.102W.

Kemp and Knight (1903) reported finding rutile in potash-rich volcanic rocks in this area. However, subsequent work in this area (Ogden, 1979) failed to confirm their observation.

Paleoplacer occurrences of rutile

Radioactive, titaniferous black sandstones of late Cretaceous age are present at many locations in Wyoming, and there is one report of a black sandstone

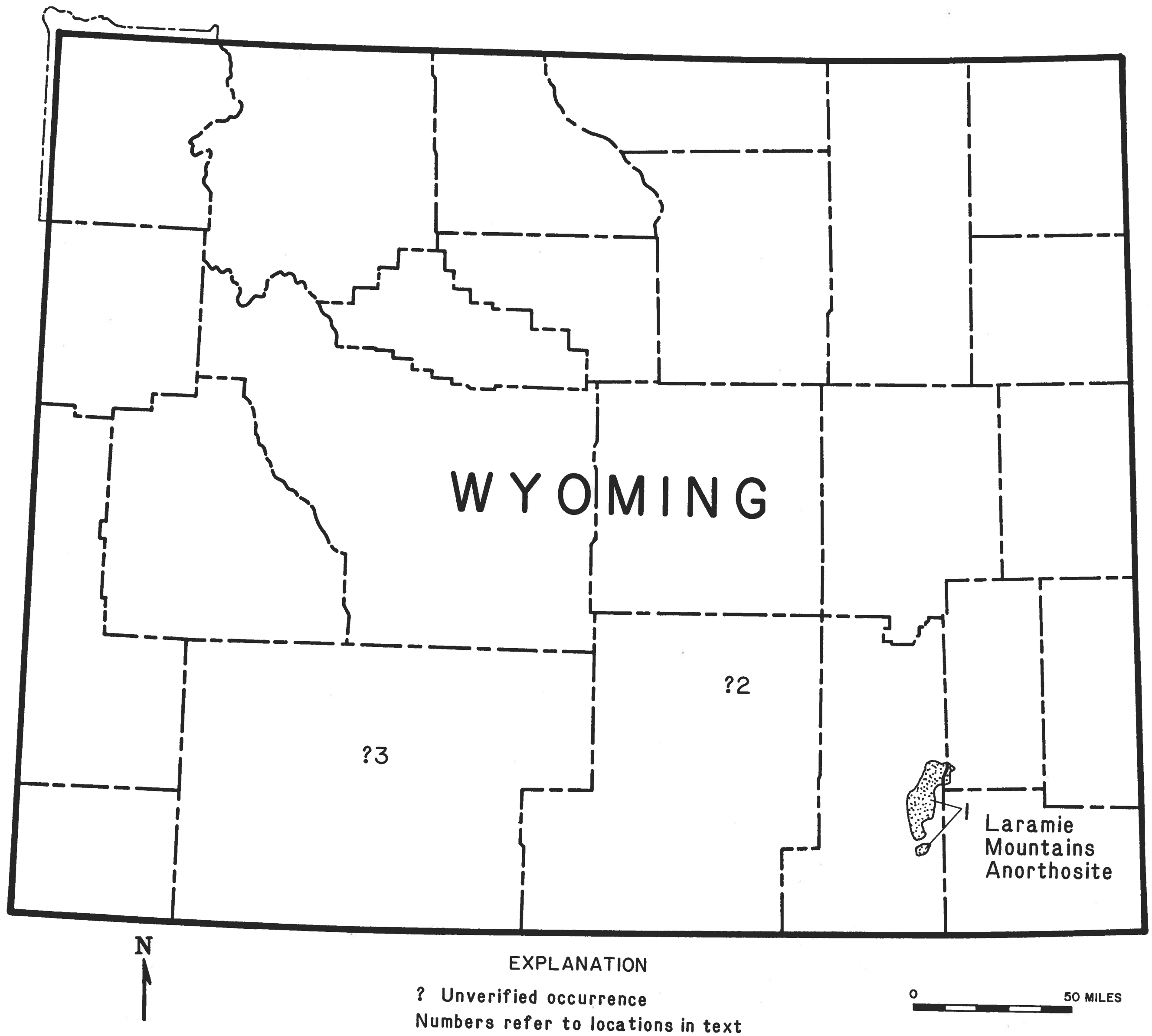

Figure 1. Igneous occurrences of rutile in Wyoming.

deposit in a rock of Jurassic age (**Figure 2**). The black sandstones are interpreted as fossil beach placers (Houston and Murphy, 1962). Rutile is present in most of these occurrences, but in amounts of 2 percent or less of the nonmagnetic fraction of the heavy minerals. These placers have been studied as a potential source of titanium from ilmenite or titaniferous magnetite (Houston and Murphy, 1962), rare earth elements (King and Harris, 1987), and uranium and thorium (for some locations in Wyoming, see Harris and others, 1985). The economics of recovering rutile from the non-magnetic fraction of these deposits is not known. **Table 2** lists some locations where rutile has been identified in black sand occurrences in Wyoming.

Table 2. Black sandstone (beach paleoplacer) deposits in Wyoming with identified rutile.

No[1] & area name	Location		Extent (feet)		Thickness (feet)		Rutile (%heavy minerals)
	Sec.	T./ R.[5]	Length	Width	Max.	Min.	
1. Cowley[2]	1, 4	56/ 97	900+	?	3.5	1.0	1.0
2. Lovell[2]	7	55/95	5,000	?	4.0	3.0	1.0
3. Dugout Creek[2]	34, 35	45/89	14,256	1,500+	25.0	11.0	1.0
4. Mud Creek[2]	9	44/91	1,500+	100+	7.5	?	1.0
5. Grass Creek deposits[2]							
Northern segment	8,9, 16	46/98	5,600	680+	16.0	11	1.0
Southern segment	33, 34	45/97	?	1,600	5.0	?	1.0
6. Cottonwood Creek[2]	26	45/97	150	150	9.0	?	1.0
7. Coalbank Hills[2]	5	34/88	1400+	?	5.0	?	1.0
8. Clarkson Hill[2]	20	31/82	150+	20+	5.0	?	trace
9. Poison Spider[2]	1	33/84	300+	?	7.0	?	1.0
10. Red Creek[2]	22	12/105	800	?	6.0	5	1.0
11. Salt Wells[2]	7	14/103	250	?	3.0	?	1.0
12. Black Butte Creek[2]	30	18/101	1,500+	?	4.0	?	1.0
13. Cumberland Gap[2]	25	18/117					
	18,19,30	18/116	13,200+	200	?	?	1.0
14. Cliff Creek[2,3]	33	38/114	?	?	?	4	trace
15. Cooper Ridge[4]	11	17/102 ?	?	?	?	?	trace

[1]Refers to locality number, Figure 2.
[2]Houston and Murphy (1962)
[3]Houston and Love (1956)
[4]Roehler (1979)
[5]Township north/Range west

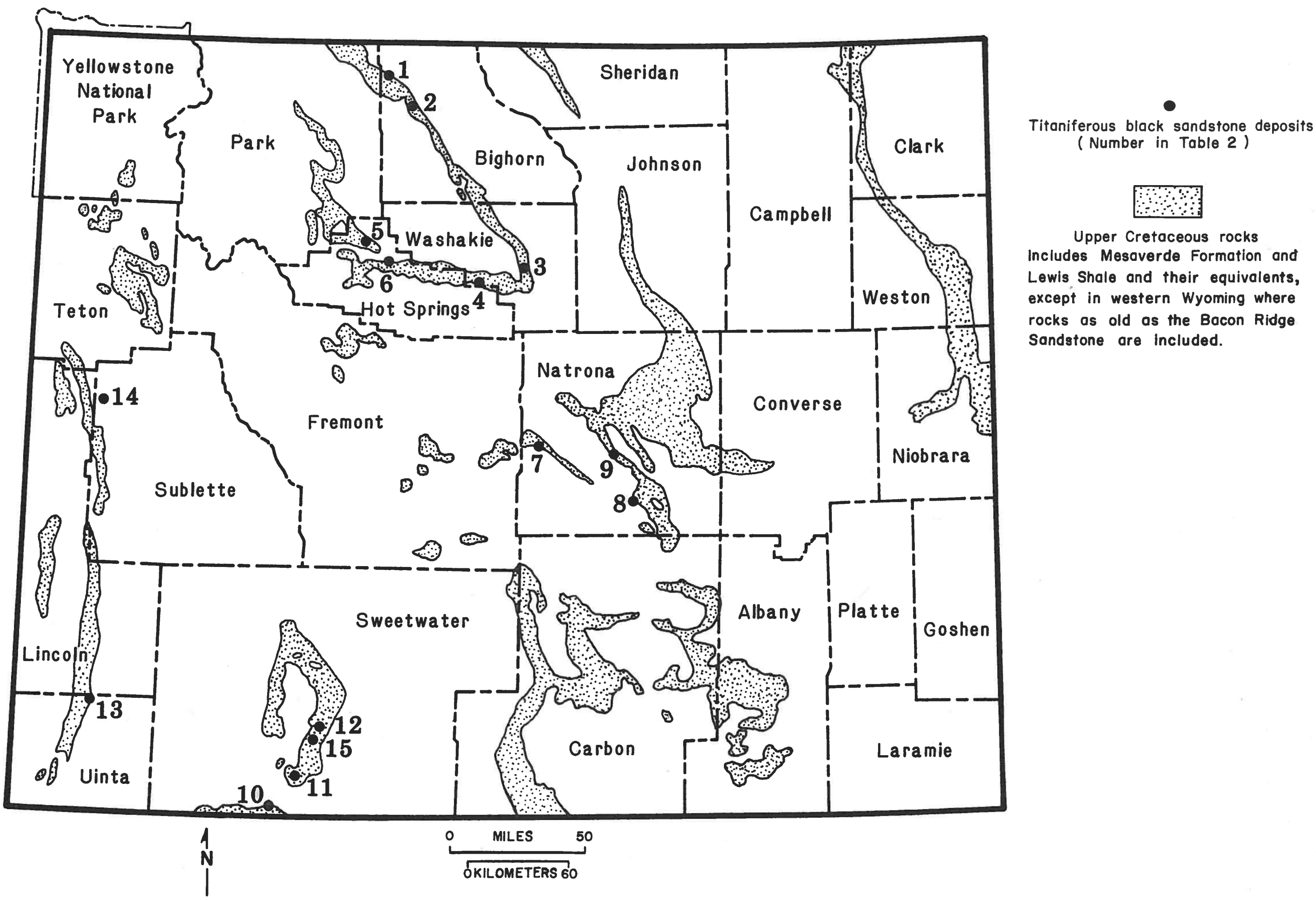

Figure 2. Locations of mesozoic titaniferous black sandstone (beach paleoplacer) deposits and outcrops of host formations in Wyoming. Numbers refer to listing in Table 2.

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