CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the Grover Heinrichs Mining Collection

**ACCESS STATEMENT**

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

**CONSTRAINTS STATEMENT**

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

**QUALITY STATEMENT**

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

# RIDDLE NICKEL DEPOSIT

By

W. A. Foster*

This paper is to be presented at the Northwest Regional Conference of the American Institute of Mining, Metallurgical and Petroleum Engineers, Portland, Oregon, April 11-13, 1957.
Permission is hereby given to publish with appropriate acknowledgments, excerpts or summaries not to exceed one-fourth of the entire text of paper. Permission to print in more extended form subsequent to publication by the Institute must be obtained from the Secretary of the Institute.

If and when this paper is published by the Institute, it may embody certain changes made by agreement between the Technical Publications Committee and the author so that the form in which it appears here is not necessarily that in which it may be published later.

* Geologist, Hanna Coal & Ore Corporation,
Riddle, Oregon

# RIDDLE NICKEL DEPOSIT

The Riddle nickel deposit is located in southwestern Douglas County in Oregon, four miles west of the town of Riddle, which is inland from the Pacific coast approximately fifty miles and north of the California border about seventy miles. The deposit was discovered in 1864. Since then much prospecting and preliminary development work has been done on the property, but no ore was shipped for other than metallurgical tests until Hanna Coal & Ore Corporation started mining operations in 1954.

The ore mineral is largely garnierite. It occurs as a lateritic concentration in an intricate meshwork of iron- and nickel-stained chalcedony boxwork in sheared and weathered peridotite. In its fresh state the peridotite contains about .2% nickel. The major axis of the ore body strikes northeast and exploration so far has shown it to be roughly 6000 feet long and 3000 feet wide. The concentration ranges in thickness from a few feet to a maximum of 250 feet. It consists of three general layers; a top, brick-red soil layer, an intermediate thick, yellow, limonitic layer with some quartz-garnierite boxwork, and a root layer composed of quartz-garnierite boxwork in nearly fresh bedrock that is a transition between weathered material and fresh peridotite.

The favorable condition of shearing and fracturing of nickel Mountain peridotite made possible the formation of the quartz boxwork and garnierite. The nickel is believed to have been derived from olivine in the peridotite by decomposition during lateritic weathering which probably took place in late Tertiary time prior to uplift and canyon cutting. The Nickel Mountain deposit is an erosional remnant that escaped destruction, and under present climatic conditions, the original laterite has been altered resulting in quartz boxwork and nickel-rich garnierite.

Exploration of the deposit is being accomplished by churn drilling and trenching. A few test shafts were put down for the purposes of studying the ore in place, determining volume and moisture factors, and gathering bulk

samples for pilot plant and smelter tests. In churn drilling, 6-inch casing is driven down every two or three feet behind the drill bit and bottomed at each 5-foot interval. All the sludge for each cased 5-foot interval is dumped through a splitter and one-eighth is saved and analyzed. Churn drill holes are stopped after going through the ore zone and penetrating fresh peridotite in which the nickel content is less than .5%.

For estimative purposes we have used conservative factors as follows:

Cubic feet per short ton in place - 17

Moisture - 21%

Grade - 1.5% Ni.

Mining of the ore is done by open pit methods, utilizing 2-1/2-cubic-yard diesel shovels and 22-ton diesel trucks. The mining plan being developed at the property consists of a series of level benches, with a twenty-foot maximum height and a fifty-foot minimum width. Each bench is intersected at several points by access roads, for moving the ore from the benches to the crushing and screening plant. The mining operation can be divided into three phases, (1) mining and hauling, (2) crushing and screening, and (3) shipping.

The ore is dug from the face of a twenty-foot bench by a 2-1/2-yard-shovel and loaded into 22-ton trucks. The ore is hauled from the benches to a stockpile area in front of the screening plant. The truck loads average about 17 tons and using one shovel it is possible to handle 2500 tons per shift. Because of the fractured state of the ore in place, practically no blasting is necessary.

In the second phase of the operation the ore is screened and crushed and deposited by conveyor belt into a conical shaped surge pile of 25,000-ton capacity to await shipment. The ore is pushed by bulldozer into a hopper which feeds a 54-inch wobbler feeder. This feeder consists of thirteen rotating

eliptical manganese bars spaced at 5 inches. Over the length of the feeder, the minus 5-inch portion of the ore passes between the wobblers and into a bin from which it is fed by a 42-inch apron feeder onto the 30-inch belt going to the surge pile. The plus 5-inch portion of the ore is carried over the length of the wobbler feeder by its rotating action, and passes down a chute into a 30 x 42 jaw crusher set at 5 inches. The crusher product can either be placed on top of the wobbler undersize on the 30-inch belt to the surge pile, or on the 24-inch conveyor belt going to the reject pile. The decision to waste or save the crusher product is made by the engineering staff. The ore on the belt from the plant to the surge pile is sampled at regular intervals as a part of the grade control procedure.

Transporting the ore from the surge pile on the mountain to the smelter stockpile at the foot of the mountain is accomplished by means of a continuous aerial tramway. In a concrete tunnel under the surge pile, the ore is fed by an apron feeder onto a 30-inch conveyor belt which deposits the crushed material in a 100-ton bin where it is stored before being loaded in the tram cars. The ore is weighed and sampled on the 30-inch belt between the surge pile and the storage bin. A 42-inch apron feeder, electrically controlled, places a measured quantity of ore from the bin, into the loader, the door of which is tripped by the moving cars. Once in the car, the ore travels a distance of 8,306 feet, and drops 2,000 feet in elevation before being deposited at the smelter stockpile. The 50-cubic-foot capacity cars each carry approximately 2-1/2 tons of ore down the mountain at a speed of 500 feet per minute. The cars, spaced 260 feet apart by a two-inch connecting cable, travel loaded on 2-inch track cables and return inverted and empty on 1-1/2-inch track cables. The tramway is held to constant speed by two 300-horsepower induction generators, which when the tram cars are fully loaded, generate 500 horsepower in the form of 375 Kilowatts of electricity being returned to the power source. Two 30-horsepower electric motors are utilized in the starting of the tramway to overcome inertia and friction in the

system when the cars are empty. Hydraulically controlled brake bands acting on the drive wheel, effectively bring the tramway to a stop when loaded or empty.

A major problem in the operation of the mine is controlling the grade of ore going to the smelter at 1.5% nickel on the daily basis. Since the formation shows no continuity the exploration drill holes can be used only for depth, rather than the sample values being projected horizontally. Daily grade control is presently being attempted by horizontal bank sampling of shovel cuts, visual classification of the banks, limiting the width of the shovel cuts to ten feet. Using these methods it is necessary to have many cuts available for mining because of the length of time necessary to dry, prepare, and analyze the bank samples. A large number of digging faces are necessary also because of the wide variation in nickel grade over the property. Several areas must be available to make up an average daily shipment.

Since mining operations were started, a little over a million tons of ore has been delivered to the smelter.