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STATE OF ALASKA
DIVISION OF MINES AND MINERALS

REPORT ON
PRELIMINARY INVESTIGATION

OF

THE KINGS RIVER AREA LIMESTONE DEPOSITS

ANCHORAGE QUADRANGLE

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Map I attached

Plates No. 1 through 6 attached

REPORT ON
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SUMMARY

The reconnaissance study of the Kings River drainage area confirmed the occurrence of extensive highgrade limestone deposits along the 6 to 8 miles of the East Fork. The deposits are considered to be of a magnitude that can supply all requirements and foreseeable future demands for cement in the Cook Inlet-Anchorage region and the railway belt.

The discovery last summer of this natural resource, after an intensive, systematic, search of the upper Cook Inlet-Anchorage region by the Permanente Cement Company's field team, in a readily accessible area that had not previously been studied or geologically mapped by a government agency or by private interests, came as a surprise to industry and to the public.

Situated in a district where the three staked areas are within 8, 16, and 17 miles, respectively, from the Glenn Allen Highway at Mile 71 to 72, it is an additional 10 miles to the railway at Sutton, where a 30 acre plant site has been acquired. An ample supply of coal and the other raw materials needed for cement manufacture are available within a few miles of the plant site.

While the three limestone areas acquired by the company are the most obvious and readily accessible, it seems reasonable to expect that within the 4 mile section downstream from Luster Creek other sections of the nearly pure limestone formation will be found along the same formation. It is anticipated that topographic conditions in this latter area will make mining costs appreciably higher.

When development and mining of this natural resource is undertaken, the operation of the cement plant will have a beneficial impact which will be felt throughout this region. It can be predicted that operation will prove a real incentive for development of other natural resources, which are an absolute requirement to create a sound year around economic climate.

INTRODUCTION

With discovery and location of a previously unmapped Limestone deposit in the Anchorage Quadrangle by the Permanente Cement Company of California in June and July 1960, a reconnaissance study of the region was requested by James A. Williams, Director, State Division of Mines and Minerals. It was made during period of September 16th to 18th, 1960 by Miro Mihelich and Martin Jasper. Pack and saddle horses were rented from Leo Kemmermyer, a homesteader and big game guide living at Drill Lake, Chickaloon district. As Mr. Kemmermyer was familiar with the area as a whole and the claims located by Permanente in particular, he was engaged as guide for the trip.

The objective of the preliminary investigation was to -

- (1) determine the location and approximate areal extent of the structure as a whole and in the areas in which the claims were located in particular;
- (2) obtain samples to determine grade (chemical analysis) of the limestone;
- (3) obtain information as to the limestone formations possible continuation along and beyond limits of the Kings River East Fork drainage basin to the north-east and southwest;
- (4) and to obtain information as to its relative accessibility for economic exploitation.

LOCATION AND ACCESSIBILITY

For reference purposes the three locations staked by the Permanente Cement Company are designated Area's 1, 2, and 3. *

Area 1 is situated approximately 1-3/4 mile N30W of Castle Mountain between the 2500 to 4300 elevation on the steep west slope of the mountain. The four limestone placer claims in this group (CAL No.s 1, 2, 3, & 4) are located about 12 miles from mouth of Kings River. The distance followed along trail from Drill Lake is estimated to be 6 miles.

These claims were the first located by Permanente, and are said to cover limits of this limestone "remnant" which is reported to be surrounded (?) by greenstone. Projection of existing Township and Section lines places them in Sections 4 and 5, Township 20 North, and Range 5 East.

Area 2, consisting of 2 limestone placer claims (CAL No.s 5 & 6) along strike of the major limestone formation of the district is the second area staked by Permanente. They are situated at approximate Longitude 148° 31' West and Latitude 61° 57' North. This area is 5 miles N35°E from mouth of the East Fork

* Refer to Map I.

to mouth of a northerly previously unnamed tributary (called Luster Creek by the locators for reference and identification purposes), thence 3/4 mile north from confluence of the latter stream with the East Fork. These claims lie on west side of Luster Creek within range of 2800 to 4400 foot elevations. **

Area 3 is a group of 6 limestone placer claims (CAL No.s 7,8,9,10,11 & 12) which are situated about 1 mile N50°E of Area 2. A central point in this group is at approximate Longitude 148° 24' West and Latitude 61° 57' North. Located on north side of the East Fork the claims lie within a vertical range of 3200 to 6000 feet elevations. They comprise the third group located by the company.** The three areas (a total of 12 Ls "Placer" claims) are presently accessible by car to Drill Lake, a distance of 84 miles from Anchorage. From Drill Lake to Area 3 over the pack and saddle horse trail is estimated at 17 miles.

There are a number of short swampy sections along 1 mile of the trail between Area 1 and mouth of the East fork, with gravel within 2 to 3 feet of the surface. Observations made during the trip indicate road construction to the limestone areas should be relatively easy.

It is understood application has been made to the State Division of Lands by Permanente for a road right-of-way into the district. Their plan is reported to be a route which would take off from the Glen Highway at about Mile 71, a mile or so southwest of Lake Ida. This route would be 9 to 10 miles shorter than it would be if it were started at end of the existing Drill Lake road. The distance from Mile 71 to Area 1 would be around 8 miles, to Area 2 about 16 miles, and to Area 3 about 17 miles. From Mile 71 to the proposed plant site on a 30 acre tract at Sutton is 8 to 9 miles, making a total distance from Area 3 to Sutton of 26 miles.

CLIMATE AND WATER SUPPLY

Climatic conditions are similar to other areas along southern fringe of the Talkeetna Mountains. Winter snow accumulations in the upper Kings River and its East Fork valleys are reported to have 5 to 6 foot maximum depths. The annual rainfall probably equals that of the Matanuska River Valley.

Stream flow of the East Fork at time of visit was estimated at 4000 to 6000 cubic feet per minute, and appeared to be greater than volume flowing in Kings River above mouth of the East Fork. Stream flow in the East Fork above Luster Creek is considered ample to supply requirements for any scale limestone mining operation that may be undertaken by the Permanente Cement Company in Area 3.

TIMBER AND VEGETATION

Only scattered spruce are to be found along the lower East Fork's valley bottom, with no spruce noted on the valley slopes. Tree growth is largely limited to small diameter fairly abundant birch, poplar, and cottonwood, with their occurrence limited to the valley bottom and a few hundred feet up the mountain slopes.***

** Refer to Map I attached and to USGS topog Maps D-4 and D-5, Anchorage Quadrangle.

*** Refer to attached Plate No.s 1 to 6.

Willow and alder are present in fairly dense growths at numerous points along the bottom and lower slopes of the East Fork valley, with the brush line within limits of the 3000 to 3500 foot contours. Above this elevation vegetation is largely limited to a thin covering of moss, short grass, and low bush blueberry plants.***

TOPOGRAPHY

The East Fork of Kings River valley is a typical "U" shaped glacier scoured area. The ridge crests, especially noticeable around limits of Area 3's "hanging valley", are serrated with highest peak on north side of the cirque having an elevation of 7185 feet. ***

HISTORY AND OWNERSHIP

The only limestone noted in this district by the USGS in the past has been limited to mention of the Area 1 occurrence, as the Kings River drainage system has not been geologically mapped or covered by detailed study. The U. S. Bureau of Mines also noted the Area 1 limestone, and years ago did some work on a coal bed 1 to 1½ miles to northeast of it.

Although prospectors and hunters over the years must have noted and recognized the limestone formation along the East Fork valley, its "discovery" and recognition of its purity and economic importance, must be credited to Permanente Cement Company's field party's thorough search for a deposit in the Anchorage-Palmer region, resulting in staking the 12 placer claims last summer as shown on the map. ***

In addition to the 12 placer claims, 2 lode claims (the RAM and EWE) ^{41 55-271} were located to cover pyrrhotite occurrences. From the Location Notice description the RAM is described as being "2 miles northerly from Hill 6394" (which in fact is actually S58° to 60°E and scales 2-3/4 miles to a peak marked 6394 foot elevation from east end of Area 2 claims.)

The EWE Lode Claim is described on Location Certificate as being "4000 feet in southerly direction from Hill 7185," which in fact is S15E and scales 0.9 mile from peak marked 7185 foot elevation on the map. This "Discovery" lies short distance east from northeast corner of Area 3 placer claim group.

GEOLOGY

With the preliminary investigation of the limestone occurrences along right limits (north and northwest side) of the East Fork confined to one day spent in Area 3, the time was largely devoted to sampling and no detailed mapping of structures was attempted. This area was selected as it has the greater known exposed width and length and the topography suggests it to be the easiest to exploit. Observations indicate the area as a whole to have a somewhat complicated structural system which would take considerable time to work out and map.

*** Refer to Map I and Plate No.s 3-4-6.

The limestone formation has a general N45° to 50°E strike in the 6 mile section from end of ridge (2 miles north of the East Fork's mouth) to head of the "hanging valley" in Area 3. It is reported to continue to the northeast to the there northwest trending East Fork, but effort to trace it further to the northeast has not been made to date. The formation has not been picked up on its projected strike to the southwest on west side of Kings River, which suggests a large displacement along the major fault in which that river valley is deeply entrenched.

The prevailing dip of the Limestone bed(s?) was not determined, and outcrops suggest it to be variable. Its outcrop on the west side of Luster Creek has an apparent dip of 50° to 60° northwest. The precipitous outcrops and peaks around the "hanging valley" in Area 3 suggest its dip in that section to be near vertical, and its great width (estimated at 3/4 to 1 mile, with a fine grained light colored acidic intrusive on northwest side of the cirque) suggests a "tight" truncated anticlinal (?) or synclinal (?) fold. ***

A large "bulge" in the limestone formation occurs to the east and north-east of the Area 3 claim group, covering an area roughly 3/4 to 1 mile in width (east-west) and 1 1/2 mile in length to the northeast, where it is abruptly terminated at the East Fork of Kings River. On the east and south sides of this "bulged" area, the limestone is in contact with granite for the most part and greenstone (andesite?) for the balance. The granite-limestone contact continues westerly to point about midway on south side of this claim group. From here to southwest limits of this staked area occasional small outcrops of a blocky slate underlies the limestone. In two draws at southwest end of Area 3 bedrock exposed in precipitous falls of small streams shows a 50 to 60 foot thickness of a brecciated greenstone "flow" remnant (?), with an estimated 200 to 300 foot thickness of weathered slates overlying the greenstone and underlying the limestone. ****

On south side of the East Fork in this area the lower slopes of the mountain are non-calcareous, highly metamorphosed, sediments, with no limestone measures in evidence.

Viewed from a distance, the mountainous area(to north and northwest) beyond the limestone formation of Area 3, shows a number of granite stocks as "islands" in surrounding sediments (and probable greenstone):

It is estimated that width of the limestone formation in Area 3 claim group will require an additional two claim widths to cover it, while within and to north and south of the cirque eight or more claim widths might be required for the mile or more distance northeast to the East Fork.

Area 2 was not examined for reasons noted above. Claims staked here were limited to two along strike of formation for distance of 1/2 mile. From a 3/4 mile distance it does not appear their 660 foot width fully covers the formation. This seems apparent as outcrops on Luster Creek's ^{east} canyon wall, viewed from distance of 3/4 mile, appears and is reported to have several times that width; *****

*** Refer to Views on Plate No.s 2-3-4-5

**** Refer to View No. 6, Plate 3, and View No. 8, Plate 4.

***** Refer to View No. 10, Plate 5

Continuing southwesterly, no prominent exposures of the limestone were noted in the next 3.5 miles downstream from mouth of Luster Creek along the northwest slopes (right limits) of the valley. It is possible that formation is obscured by the light snow cover above the 4000 foot level. However, the limited light colored exposures on the steeper slopes a short distance below the snow line could possibly be limestone, but no limestone "float" was noted in lower end of the draws of this 3.5 mile section. ****

In the 3.5 to 4.0 mile section below mouth of Luster Creek there is a prominent precipitous exposure of the limestone in bluff at top of the northwest valley slope. "Float" in gulch below this exposure shows the limestone to be generally impure, with considerable silicification and pyritization noted. Because of its apparent impurities this occurrence was not examined, and no doubt is reason for no effort being made to stake it by agents of the Permanente Cement Company.

For 2.5 miles along lower southeast side of the East Fork valley, and for an additional 1.75 miles below mouth of East Fork, on east side of Kings River, the formation appears to be limited to the "white" granite and small isolated areas of greenstone, with the granite having an estimated width of 1.0 to 1.5 miles.

Area 1, located about 1.0 mile east of Kings River and about 2 miles downstream from mouth of East Fork, is reported to be surrounded by greenstone (andesite?). About 0.75 mile northeasterly of Area 1, there is an elongated occurrence of a dolomitic limestone along a steep narrow ridge reportedly traced for about 1.0 mile. Neither of these two occurrences were examined, as both of them appear to be "remnants". *

Faulting

The short tributaries on both sides of the East Fork are entrenched along planes of a "block" faulting system of a general northwesterly strike, with displacement of the limestone formation considered to be of minor importance. Luster Creek lies within a fault zone, which from a 3/4 mile distance suggests a horizontal displacement of 100 to 200 feet.

The northwesterly trending sections of Kings River and the East Fork are entrenched in major fault zones along which displacements of real magnitude occurred. This is evident by failure, to date, to locate continuation of the Limestone formation to southwest of Kings River and to the northeast of the East Fork.

Mineralization

The known mineral concentrations along this limestone belt are limited to two "massive" pyrrhotite occurrences in limestone-granite contact areas. The EWE and RAM lode claims (mentioned above) were located to cover these deposits. It is reported that samples taken carried no copper, nickel, gold, nor silver values and the deposits are not considered of special interest at the present time. Disseminated pyrite was noted in limestone "float" near southwest end of this

**** Refer to Views No. 3 & 4, Plate 2.

* Refer to Map I.

formation. Minor amounts of chalcopyrite and malachite have been reported at several points, but were not considered to be of special interest. The limestone-intrusive contacts, however, should be more thoroughly prospected as similar areas in other regions have proven to be a "favorable" environment for ore deposition in many cases.

Sampling

Sampling was limited to two sections in Area 3 claim group, neither of which included the full width of the formation. Total width (or thickness) of the limestone was not determined with any degree of certainty at either section.

Sample No.s 313-314-315 were taken across a continuous total width of 500 feet (paced) from southeast to northwest, beginning approximately 200 feet from southeast limestone-granite contact, more or less at right angles to the northeast-southwest strike of the limestone formation. This section is located in the "flat" area near southwest end of the glacial cirque, where the limestone outcrops are differentially weathered, "heaved" talus "slabs".

Sample No.s 313 and 314, taken by Mihelich and totaling 200 feet, were chips at 1 foot intervals; sample 315, taken by Jasper across 300 feet, were chips at 5 foot intervals. Elevation along this line was 4750 (by aneroid).

Sample No.s 316-317-318 were taken down a draw along a course bearing S10W, which is at a 45 degree tangent to general strike of the limestone formation. The sampling began at point an estimated 1000 feet S10W of first section sampled.

Sample No. 318, with chips taken at 10 to 15 foot intervals from outcrops, was 1100 feet in length. This section has a 10 to 15 degree slope, and a vertical range of about 4550 to 4400 foot elevation.

Sample No.s 316-317, taken by Mihelich at 5 to 10 foot intervals, were down an average 30 degree slope for 500 feet (horizontal distance about 400 feet), between the 4300 and 4100 elevations. Between sample No.s 318 and 316 a distance of 100 to 150 was not taken, due to few limestone bedrock exposures.

In the 200 to 300 feet from the southeast limestone-granite contact (some of which was included in Sample No. 313), the limestone has a typical marbelized, mottled, light blue-gray color and is fine grained. Beyond that to the northwest within limits of the sample it is coarsely crystalline and white.

Megascopically, impurities - except minor humus stain - were considered negligible, and in the field it was estimated to be a practically pure CaCO_3 deposit.

Analysis of the samples gave the following results:

CHEMICAL ANALYSES

Assay No. *	Sample No.**	LOI***	CaO	MgO	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃
12278	313	42.3%	52.9%	0.08%	0.55%	2.16%	Not run
12279	314	42.8	54.6	0.11	0.62	1.89	
12281	315	43.7	54.9	0.16	1.01	0.64	
12280	316	42.1	55.5	0.17	0.53	0.57	
12282	317	43.1	55.1	0.13	0.62	1.17	
12283	318	43.4	55.1	0.25	0.47	0.81	

* Assay No. of Anchorage Assay Office

** Field sample tag No.

*** LOI - Loss on Ignition

"Split pulp samples were sent to the Ceramic Laboratory of the USMB Northwest Experiment Station, Seattle, for a "check" analysis, results of which are as follows:

CHEMICAL ANALYSES*

Sample No.	LOI	CaO	MgO	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃
313	43.0%	54.7%	-0.1%	0.16%	1.47%	0.68%
314	43.7	55.5	-0.1	0.15	0.65	0.33
315	43.7	55.7	-0.1	0.17	0.38	0.29
316	43.8	55.5	-0.1	0.10	0.39	0.38
317	43.6	55.9	-0.1	0.06	0.40	0.36
318	43.6	55.7	-0.1	0.08	0.40	0.42

* QUOTE:- "Differential thermal analyses of these samples showed them to be nearly pure CaCO₃, the thermal reaction was sharp and of such a magnitude that indicated very pure calcium carbonate. All of the samples were white after firing." UNQUOTE.

It is interesting to note that samples 313 and 314, composed of chips taken at 1 foot intervals, agreed closely with chips taken at 5 foot intervals in No. 315. The principal difference was in the silica content, with the first two being the higher, probably due to their proximity to the limestone-granite contact.

The analyses confirm the field observation of Mr. Mihelich that, in his opinion, the obvious uniformity and purity of the deposit would show same results whether it was channel sampled or limited to "chips" taken at regular intervals.

CONCLUSIONS

The limestone deposits located in the Kings River drainage system are extensive, and information gathered from this preliminary investigation indicates nearby practically inexhaustible reserves of nearly pure calcium carbonate suitable for almost any use. Sampling by others of the three areas is reported to show the limestone to have the same nearly pure CaCO_3 content.

From a mining point of view the topography, width, and visible lateral extent of the limestone in vicinity of Area 3, should realize lowest costs in planning a long range operation.

Area 2 outcrops, although not examined except from a distance, also indicates presence of a very large tonnage potential. Here, however, the slopes are very steep and mining costs would probably be somewhat higher.

The more limited nature of the Area 1 limestone deposit indicates its tonnage potential to be a small fraction of that available in the other two areas. Reported to be surrounded by andesite, it is possible that this 80 acre remnant may have sufficient tonnage of nearly pure CaCO_3 to supply the planned cement plant at Sutton for all requirements in the foreseeable future. Should a diamond drilling program prove that to be the case, this deposit would be the logical one to exploit first as it is located within 8 miles of the highway, and would save 8 to 10 miles of road construction and truck haul.

Anchorage, Alaska
January, 1961

By- *Martin W. Jasper*
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SEP 60

View No. 1. Sept. 6, 1960

Looking due north across Lake Ida from Glenn Allen Highway. Castle Mt. in right background with Castle Mt. Coal Co. on lower slope hidden by trees at right. Area 1 limestone deposit on west slope at north end of Castle Mt. in center background. Airline distance 6.25 miles.



SEP 60

View No. 2. Sept. 16, 1960. 9 AM.

Departure from Drill Lake, Chickaloon district, on East Fork of Kings River limestone investigation.



SEP 60

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Panoramic view No.s 3 & 4. Sept. 17, 1960. 11 AM

Looking westerly down the East Forks "U" shaped glaciated valley to its junction with Kings River. Mouth of Luster Creek in left foreground. Area 2 shows on ridge slope on west side and at lower end of Luster Creek canyon in right center background, with a limestone outcrop of Area 3 showing on bank of a ravine between Area 2 exposure and an outcrop of granite at extreme right center. Views taken at 4100 elevation.

PLATE 2



SEP . 60

View No. 5. Sept. 17, 1960. 3 PM

Looking SW along general trend of limestone formation from SW end of Area 3's "hanging valley" (cirque) from about 4750 elevation. Differentially weathered limestone "slabbed" bedrock in foreground.



SEP . 60

View No. 6. Sept. 18, 1960. 9 AM

Looking N10 to 15E from campsite into "cirque" of Area 3. Gray peak at right is limestone with "dark" area at its base being granite. Gray peak on left side is also limestone, with white spots on slopes being general strike of the formation.



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View No. 7. Sept. 18, 1960. 9 AM
Looking NE into "cirque" of Area 3 from valley half mile downstream from campsite. Peaks on both sides and ridge at head of "cirque" (light gray) are limestone.



SEP

60

View No. 8. Sept. 18, 1960. 10 AM
Looking NE into "cirque" of Area 3 from valley about $\frac{1}{2}$ mile above mouth of Luster Creek.



SEP - 60 -

View No. 9. Sept. 18, 1960. 9 AM
Looking westerly from campsite about 1 mile above Luster creek, showing Area limestone outcrops on west side of Luster Creek canyon. Gray outcrops in center background appear to be limestone, but not examined to confirm.



View No. 10. Sept. 18, 1960. 10 AM
Looking north into Luster Creek canyon from short distance below mouth of that stream, with Area 2 on left side. Note greater width of limestone exposed on right side and apparent flatter dip of formation.



View No. 11. Sept. 18, 1960
Looking NE into "cirque" of Area 3 showing limestone peaks on each side. Taken from point 2 miles above mouth of East Fork.



View 12. Sept. 12, 1960. 11:30 AM
Looking NW from same point as View No. 11. Limestone bluffs at top of slope are SW limits of formation to date. "Float" in gulch for most part was impure Ls - bluffs were not examined for that reason.