Preliminary study of the heavy minerals from cores of Tertiary rocks in the Deep Creek Unit well, Kenai Peninsula, Alaska

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Introduction

This report describes a preliminary investigation of the feasibility of using heavy minerals to aid in the identification of major stratigraphic units of Tertiary age in the Cook Inlet basin, southern Alaska. The work is based on a study of selected cores from the Standard Oil Company of California No. 1 Deep Creek Unit well, about 25 miles north of Homer (fig. 1) in sec. 15, T. 2 S., R. 13 W., Seward base and meridian. The study was directed primarily toward easily recognized variations in heavy-mineral content. To this end, identification and tabulation of the more abundant nonopaque heavy minerals was emphasized, although each sample was checked for significant minor constituents.

The results of this study are restricted by the limits of the sampling. Samples are not evenly distributed and do not adequately represent all of the possible variations in the section; this is particularly true of the upper part. The results of this study are restricted to one well. Kirschner and Lyon (1973) presented the general aspects of the heavy mineralogy of the Tertiary rocks underlying the Cook Inlet basin and the Matanuska Valley region.

The stratigraphic nomenclature for the Tertiary rocks is adapted from Calderwood and Fackler (1972). These rocks are assigned to the Kenai Group and are divided, in upward order, into the West Foreland Formation, Hemlock Conglomerate, Tyonek Formation, Beluga Formation, and Sterling

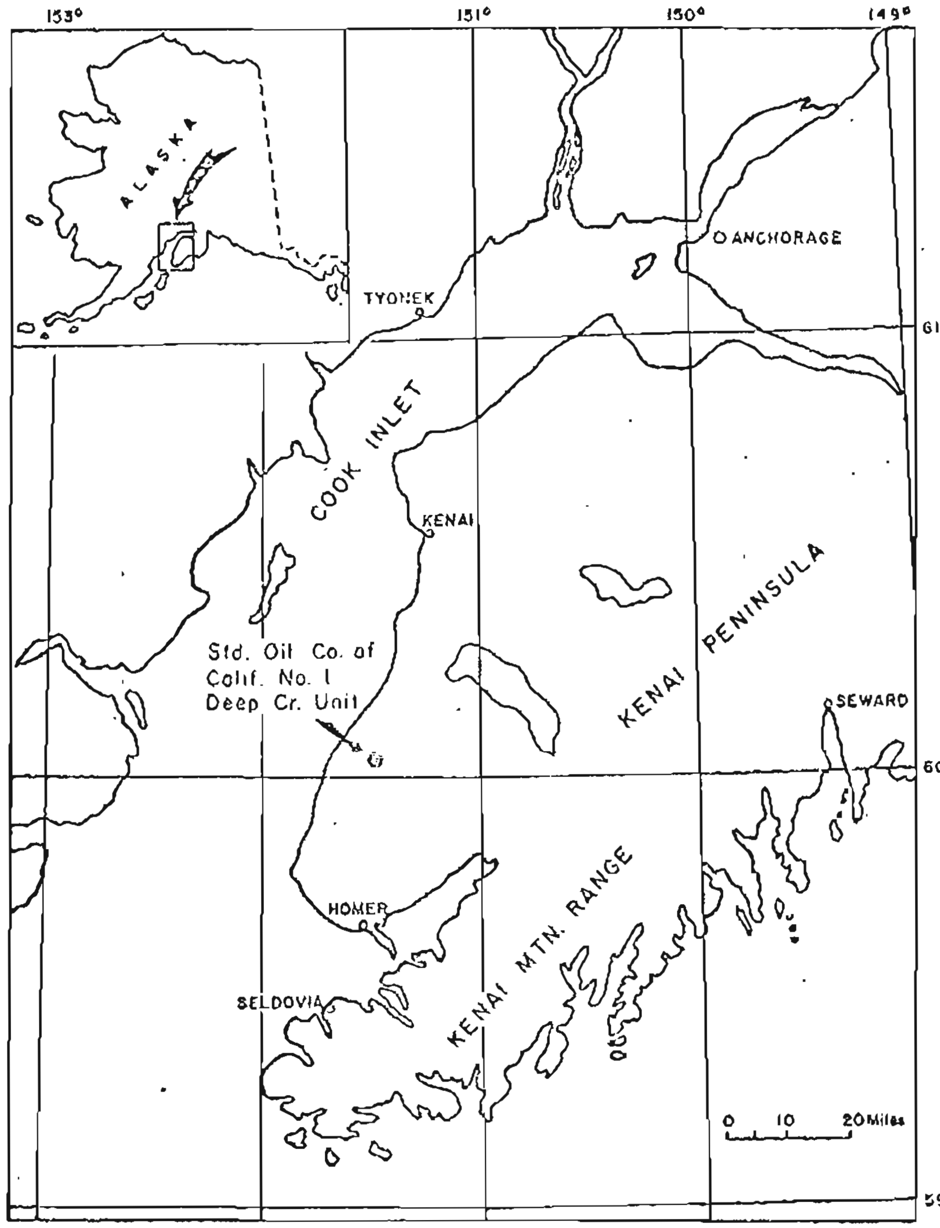

FIGURE 1. LOCATION OF STANDARD OIL CO. OF CALIFORNIA NO. 1 DEEP CREEK UNIT, KENAI PENINSULA, ALASKA

Formation (pl. 1). Age assignment is that used by Adkison and Newman (1973) who established a reference section for Tertiary rocks in the Deep Creek well.

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Procedure

Sandstone and siltstone samples were taken from selected cores representing each formation in the well. The samples were disaggregated mechanically, and if necessary, they were treated with cold 5N HCl. The disaggregated samples were washed with water to remove as much clay-size material as possible, dried, and sieved. The size fraction greater than 0.124 mm but less than 0.61 mm was collected for heavy-mineral separation. These fractions were placed in separatory flasks equipped with stop cocks. Bromoform with a specific gravity of 2.86 was used for the initial separation. The resulting heavy fractions were further treated with bromoform of specific gravity 2.86 in a centifuge. The heavy residues of this operation were treated with a mixture of methylene iodide and bromoform having a specific gravity of 2.99. Tramp iron and magnetite were removed by hand magnet.

The heavy-mineral fractions obtained through the foregoing process were split if the volume of sample permitted. One split was subjected to qualitative analysis by means of X-ray diffraction. Samples of all heavy-mineral residues were cemented to glass slides with Lakeside 70. The slides were examined quantitatively using a petrographic microscope equipped with a mechanical stage. Between 100 and 150 nonopaque monomineralic grains were counted on each slide. These counts were reduced to percent abundance for each mineral and tabulated stratigraphically (table 1).

Results

Heavy-mineral residues from the five formations of the Kenai Group are similar in some respects. Nine minerals and mineral groups make up the principal constituents of the monomineralic grains. They are apatite, biotite, chlorite, epidote, garnet, green hornblende, muscovite, sphene, tourmaline, and zircon (table 1). Of these minerals, only green hornblende appears restricted to one part of the group. Eight other minerals, mostly questionably identified, occur in minor quantities. Rock fragments make up a significant portion of each sample. The abundance of individual minerals in the heavy-mineral residues varies from one part of the Kenai Group to another (pl. 1). This variability generally appears to increase toward the top of the group.

For stratigraphic subdivision of the Kenai Group, some minerals probably are more useful than others. The most useful minerals probably are green hornblende, garnet, and epidote. Chlorite is probably the least useful mineral because samples with a surfeit of chlorite (samples 8-3, 19-3, and

TABLE I. ANALYSES OF HEAVY MINERAL SAMPLES

AGE	Miocene and Pliocene											Oligocene ? and Miocene			Eocene	
FORMATION	Sterling Formation		Beluga Formation			Tyonek Formation						Hemlock Conglomerate			W. Foreland Formation	
SAMPLE NO	1-2	2-3	3-1	4-1	8-3	9-1	17-2	19-3	43-2	45-5	49-3	50-2	51-2	52-2	24-3	26-1
Principal Constituent Minerals - percent																
Apatite	11	25	29	31	–	8	23	–	5	9	1	2	–	1	–	–
Biotite	7	24	8	12	23	3	5	18	1	6	6	7	8	2	2	–
Chlorite 1/	–	–	4	–	65	–	10	51	2	14	14	19	10	6	2	68
Epidote 2/	60	27	6	13	4	27	5	8	65	52	53	–	1	14	58	14
Garnet 3/	–	9	6	23	–	12	37	15	8	7	10	35	54	64	10	9
Green Hornblende	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18	3
Muscovite	–	7	20	1	8	1	4	2	1	2	1	3	–	3	–	–
Sphene	13	1	17	8	–	45	1	2	6	7	11	11	7	3	–	–
Tourmaline	tr.	6	10	8	–	2	5	2	7	2	3	8	11	4	3	–
Zircon	9	1	–	4	–	2	10	2	5	1	1	10	4	3	7	4
Minerals Present in Minor Amounts - percent																
Anatase												5	5			2
Dumortierite						tr.										
Hypersthene ?		tr.	tr.				tr.									
Kyanite ?		tr.														
Rutile ?														tr.		
Sillimanite?		tr.					tr.									
Spinel ?		tr.														
Staurolite ?		tr.					tr.					tr.	tr.	tr.		
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

tr. = trace

1/ Includes all minerals of Chlorite Group; some samples include appreciable amounts of penninite

2/ Includes all minerals of the Epidote Group; mostly epidote, however some samples include appreciable amounts of zoisite and clinozoisite

3/ Includes almandite and other varieties

26-1) include very few other monomineralic grains. In chlorite-rich samples, the ratios between abundances of nonopaque minerals differ greatly compared to the ratios between abundances of the same minerals in other samples from the same formation, but poor in chlorite.

Four stratigraphic intervals appear to be recognizable from their heavy-mineral content. These intervals correspond to the West Foreland Formation, Hemlock Conglomerate, basal part of the Tyonek Formation, and the overlying rocks of the Kenai Group. With the exception of the West Foreland Formation, these intervals can be recognized by comparing the abundance of the principal constituent minerals common to all the intervals with one another.

The West Foreland Formation is the only formation that includes an unique heavy mineral, green hornblende. This mineral was not seen in samples from overlying rocks, and thus it apparently distinguishes the West Foreland from other parts of the Kenai Group. A sample from the middle of the formation contains abundant epidote, but this mineral is abundant in several samples from the overlying formations.

The three samples from the overlying Hemlock Conglomerate are rich in garnet. This mineral accounts for more than 50 percent of all monomineralic grains in two of the samples, and its abundance serves to differentiate the Hemlock from the other formations of the Kenai Group.

Epidote is the predominate heavy mineral in the three samples from the basal part of the Tyonek Formation. Over 50 percent of the monomineralic grains in these samples are epidote. None of the other heavy minerals individually account for more than 15 percent of the remaining part of the samples. Thus the abundance of epidote generally serves to differentiate the basal part of the Tyonek Formation. As noted above, epidote is abundant near the middle of the West Foreland Formation, but this formation is identified by green hornblende. Epidote also dominates the heavy-mineral suite from the upper part of the Sterling Formation. These rocks lie about 11,000 feet above the basal part of the Tyonek Formation, and several samples from the intervening strata contain small to moderate amounts of epidote.

Samples from rocks above the epidote-rich basal part of the Tyonek Formation are notably variable in heavy-mineral content. The lack of an obvious predominance of one mineral or group of minerals is the only feature that sets apart the samples from this part of the Kenai Group. Although the abundanse of epidote in the sample from the upper part of the Sterling Formation is much greater than in the samples from the lower part of the Sterling Formation and the underlying Beluga Formation, the variability within these samples suggests this is not a meaningful difference.

This study has yielded some positive results. It demonstrates the existence of easily recognized differences in heavy-mineral suites that probably will aid in correlation and interpretation of economically important subsurface units. Recognition of stratigraphically important variations in heavy mineralogy requires examination of a reasonably complete set of samples from the Kenai Group because most of the definitive variations occur as concentrations of minerals probably common to the entire group. The difference in concentration of some heavy minerals suggests the use of rotary samples to be potentially feasible, although contamination through caving and recirculation would partially obscure the results. This study provides reasonable evidence for further investigation of the use of heavy minerals in the stratigraphic study of the Kenai Group.

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