MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-2494
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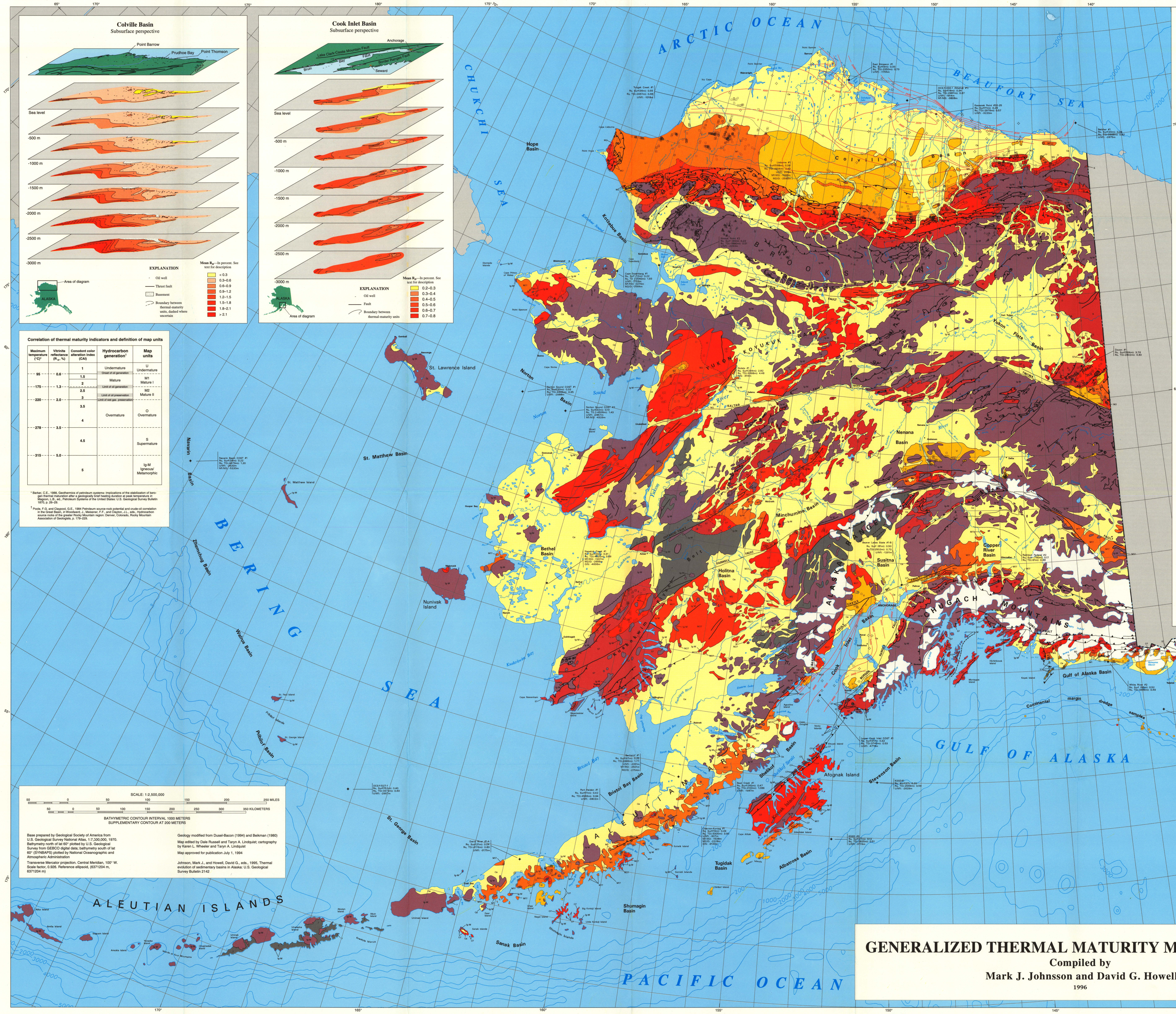
PLATE 1



GENERALIZED THERMAL MATURITY MAP OF ALASKA

Compiled by

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EXPLANATION

Thermal-maturity units—R_o, reflectance value in oil; CAI, Conodont Color Alteration Index. See text for explanation

- U — **Undermature**—$R_o < 0.6$, CAI < 1.0
- M1 — **Mature I**—R_o 0.6–1.3, CAI 1.0–2.0
- M2 — **Mature II**—R_o 1.3–2.0, CAI 2.0–3.0
- O — **Overmature**—R_o 2.0–3.6, CAI 3.0–4.0
- S — **Supermature**—R_o 3.6–5.0, CAI 4.0–4.5
- Ig-M — **Igneous-Metamorphic**—$R_o > 5.0$, CAI > 4.5
- ? — **No data**
- Qs — **Quaternary sediments (unconsolidated)**
- **Glacial cover**

Thermal-maturity unit contact—Dashed where inferred, dotted where concealed

High-angle fault—Dashed where inferred, dotted where concealed

Thrust fault—Dashed where inferred, dotted where concealed

Detachment fault—Dashed where inferred, dotted where concealed

2000 **Contour on U/M1 unit boundary**—Elevation of U/M1 thermal maturity map-unit boundary (0.6% vitrinite reflectance isograd). Values, meters below sea level

Sample localities—Many localities represented by multiple samples. Where shown, color indicates thermal maturity map unit

- **Vitrinite reflectance**
- **Conodont Color Alteration Index**

Subsurface data

Selected oil well with vitrinite reflectance data—All elevations and vitrinite reflectance values are from regression lines drawn through the data; this line may be extrapolated slightly below the well bottom

	Well name
Becharof #1	Kelly bushing elevation, meters above sea level
R_o, Surf(67m): 0.25	Vitrinite reflectance at surface (%)
R_o, TD(-2683m): 1.77	Vitrinite reflectance at total depth (%)
U/M1: -2351m	Hole bottom, meters below sea level
M1/M2: -2501m	Contacts between thermal map units, meters below sea level
M2/O: -2754m	

Other oil well—Used to constrain contoured U/M1 thermal maturity map-unit boundary (0.6% vitrinite reflectance isograd) in Cook Inlet and North Slope regions

City

INTRODUCTION

Thermal maturity is a measure of the level of thermal alteration of organic matter in sedimentary rocks. Inasmuch as different types of organic matter respond differently to heat, thermal maturity is operationally defined differently for different substances. Accordingly, many organic and mineral indicators of thermal maturity have been proposed and, to a certain degree, crosscorrelated (see, for example, Hood and others, 1975; Scholle and Schluger, 1979; Héroux and others, 1979). The thermal maturity of organic matter provides a means of ascertaining the maximum temperatures to which sedimentary rocks have been exposed. Diagenetic or low-grade metamorphic temperatures, in regions where [illegible]

VITRINITE REFLECTANCE

[illegible]

CONODONT COLOR ALTERATION INDEX

[illegible]

SYNOPSIS OF THERMAL MATURITY PATTERNS IN ALASKA

[illegible]

Glenn Creek Fault, which may represent a terrane boundary in east-central Alaska (Johnsson and others, 1993).

Although complicated by the effects of convective heat transfer by fluids and spatial variations in heat flow, thermal maturity data from sedimentary rocks isolated from igneous activity largely reflect burial heating and thus provide a means of assessing vertical movements in the upper crust. Thermal-maturity patterns in Alaska reflect the complex tectonic history of the region. The amalgamation of terranes with different thermal and uplift histories produces a patchwork of sharply contrasting thermal maturity. Sedimentary basins developed on these terranes record the history of terrane accretion through differential regional uplift. A varied thermal-maturity pattern in these deposits indicates a complex pattern of uplift that is not readily apparent from traditional mapping of stratigraphic and structural relations.

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SOURCES OF DATA

Data for this map have been compiled from the literature cited below, unpublished industry reports provided to the Alaska Division of Geological and Geophysical Surveys, previous USGS investigations, data contributed by industry, academic and government colleagues, and by our own sampling and analysis where needed. Quantitative data used in the preparation of the map were restricted to vitrinite-reflectance and Conodont Color Alteration Index analyses because these types of data are the most common and best quantifiable thermal-maturity data available in Alaska. The database behind this map (Johnsson and others, 1992), consists of 3,716 vitrinite-reflectance determinations from 2,123 outcrop localities, 1,474 Conodont Color Alteration Index determinations from 1,306 outcrop localities, and 4,482 vitrinite-reflectance determinations from 217 wells.

Where vitrinite-reflectance or Conodont Color Alteration Index data were sparse or unavailable, other organic and inorganic thermal-maturity data from the literature cited below were used to help constrain thermal maturity. Such data include: Rock-Eval pyrolysis (T_{max}), thermal-alteration index (TAI), fluid inclusion, illite crystallinity, zeolite mineralogy, and fission-track data. In particular, the laumontite-prehnite-pumpellyite facies of Dusel-Bacon (1994) generally correlates with the supermature thermal-maturity unit defined by vitrinite-reflectance and Conodont Color Alteration Index data, and Dusel-Bacon (1994) was accordingly used to constrain the supermature thermal-maturity map unit in places.

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