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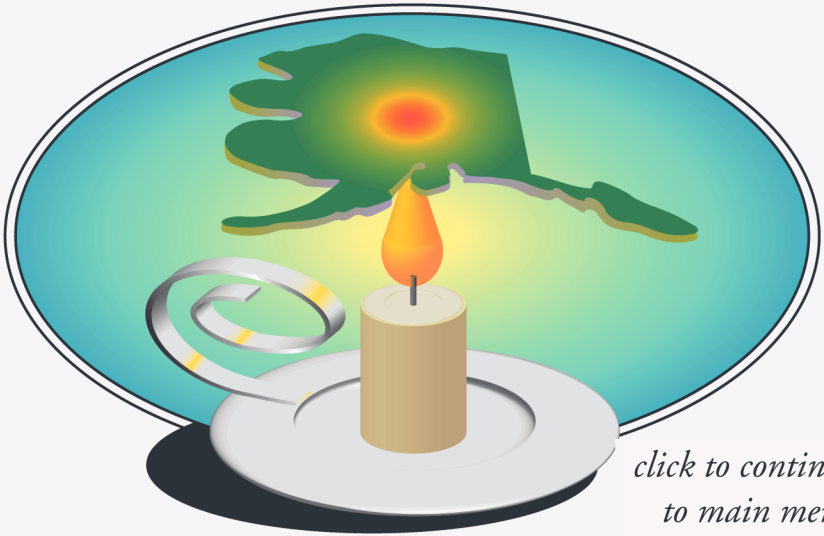
Thermal Maturity of Sedimentary Rocks in Alaska: Digital Resources

By Mark J. Johnsson, Kevin R. Evans, *and* Heather A. Marshall



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Thermal Maturity of Sedimentary Rocks in Alaska: Digital Resources

U.S. Geological Survey Digital Data Series DDS-54

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This CD-ROM is an updated re-release of three USGS publications on the thermal maturity of sedimentary rocks in Alaska:

Vitrinite reflectance and conodont color alteration index data from Alaska: Data to accompany the thermal maturity map of Alaska: U.S. Geological Survey Open-File Report 92-409 (1992).

Generalized thermal maturity map of Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-2494, scale 1:2,500,000 (1996).

Thermal evolution of sedimentary basins in Alaska: U.S. Geological Survey Bulletin 2142, 131 p. (1996).

This release allows access to digital versions of these reports and to the data underlying them. An interface built around Adobe's Portable Document Format (PDF) allows easy navigation around these products, whereby they may be easily viewed and printed. In addition to the pdf format, data are provided in Microsoft Excel format to allow manipulations in a spreadsheet program, and in ASCII format for export to more sophisticated database-managment or other programs. The "Generalized Thermal Maturity Map of Alaska" was produced using Environmental Systems Research Institute's ARC/INFO Geographic Information System (GIS), and this CD-ROM includes the entire workspace needed to export these databases for use in ARC/INFO or other GIS software supporting the ARC/INFO format. In addition, industry-standard shapefiles are included to allow export to other GIS software.

Click on the buttons to the right to view the PDF versions of these products.

Abstract

Thermal Maturity Data

Thermal Maturity Map

Interpretive Report

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Abstract

Alaska is a complex amalgamation of tectonic blocks with diverse histories. Sedimentary basins that are formed on these blocks both before amalgamation and as a result of collisions between them record the tectonic history of this complex region. Thermal-maturity data—indicators of maximum burial temperatures—provide important constraints both on basin evolution and on terrane amalgamation. To help elucidate these relations, and to provide constraints for hydrocarbon assessments, the U.S. Geological Survey (USGS) has compiled thermal-maturity data from Alaska for many decades. This report is a digital release of our current understanding of thermal-maturity patterns in Alaska.

Sedimentary rocks in Alaska can be classified into at least four categories based on basin type and thermal-maturity pattern. The Tertiary interior basins are at very low thermal maturity, indicating that these basins are at or near maximum burial, have seen little uplift and exhumation, and probably are thermally immature at depth with respect to hydrocarbon generation. A second class of sedimentary rocks is found in the Aleutian forearc and backarc basins. These rocks are similarly at very low thermal maturity at the surface, except where near igneous heat sources (the Aleutian volcanoes). One of these basins, the Cook Inlet Basin (in the Aleutian forearc), shows greater thermal maturity at the basin margins, probably indicative of relatively greater uplift at the basin margins than at the basin center, which appears to be presently at its maximum burial depth. Uplift in the Cook Inlet Basin may reflect compression along the faults bounding the basin. A third class of sedimentary rocks is found in the Colville Basin on the North Slope. Thermal maturity patterns in the Colville Basin are broadly asymmetric, indicating systematic differential uplift ranging from a minimum of no uplift in the north (Point Thomson area) to 9–13 km of uplift and exhumation in the central Brooks Range. This pattern may reflect deflexing of the lithosphere subsequent to the principal episode(s) of crustal convergence and thickening. Thermal-maturity isograds within the Brooks Range cut major thrust faults, indicating that maximum burial postdated the principal phases of thrusting. In contrast, isograds in the foothills belt to the north are warped broadly by local structure, indicating continued north-south shortening subsequent to maximum burial.

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Abstract (continued)

A broad southward extension of thermally immature rocks in the central part of the foothills belt suggests relatively young east-west shortening (parallel to the strike of the orogen), a feature that to date has not been included in regional tectonic syntheses. The fourth major environment of sedimentary rocks in Alaska is in tectonically disturbed or dissected basin fragments. Many of these basins show elevated levels of thermal maturity at the surface, with higher values at basin margins. This geometry, particularly well documented in the Yukon-Koyukuk Basin, suggests a pattern of greater uplift along basin margins, possibly reflecting isostatic readjustments as crustal loads are removed by erosion. In the Kandik Basin of east-central Alaska, a thermal-maturity anomaly—thermally mature younger rocks in fault contact with thermally immature older rocks—provides clues to the nature and timing of east-west thrusting. Mesozoic foreland-basin deposits associated with thrusting buried Paleozoic rocks of the easternmost part of this fold-and-thrust belt to relatively shallow depths. The western foreland-basin deposits were overridden by advancing thrusts and tectonically buried as deep as 10 km.

These preliminary interpretations, based in part on USGS thermal-maturity data, are presented in graphical form as the "Generalized Thermal Maturity Map of Alaska" (Map I-2494), and as a series of papers in the volume "Thermal Evolution of Sedimentary Basins in Alaska" (Bulletin 2142), both included on this disk. We hope that these materials will stimulate further interpretations based on these and additional data.

Acknowledgments

The effort to compile all existing public thermal-maturity data from Alaska and to draw from those data a large-scale overview of thermal maturity patterns in Alaska was suggested by David G. Howell and Kenneth J. Bird, who provided unstinting support throughout the many years of this project. We would like to express our sincere thanks to all those individuals who have contributed unpublished data or samples to this project; their names are listed in the acknowledgments of the individual products on this CD-ROM. Special thanks are extended to A.G. Harris, who made available her complete Alaskan inventory of conodont-color-alteration-index data, and to M.J. Pawlewicz, who produced hundreds of vitrinite-reflectance determinations. Z.C. Valin extracted hundreds of vitrinite-reflectance determinations from industry reports and the literature; he and C.F. Hamilton also assisted with data input. Leslie B. Magoon was instrumental in organizing data collected over the past two decades by USGS scientists. Assistance in the field was provided by David G. Howell, Michael B. Underwood, Donald L. Gautier, Christopher J. Schenk, Thomas Brocculeri, Lu Huafu, Paul B. O'Sullivan, William Arendt, Patrick McClung, Nomane Fehri, François Roure, and Pascal Desegaulx. T.T. Fitzgibbon and P.K. Showalter provided a tremendous amount of early assistance with ARC/INFO, and Karen Wheeler and Taryn Lindquist helped get the final map produced. Similarly, James W. Hendley II worked mightily to produce the final version of the Bulletin. Finally, we extend many thanks to Michael F. Diggles for his help and advice in producing this CD-ROM.

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