Studies by the U.S Geological Survey in Alaska, 2001

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Introduction

By John P. Galloway

The collection of 14 studies that follow continues the series[1] of U.S. Geological Survey (USGS) investigative reports in Alaska under the broad umbrella of the geologic sciences. This series presents new and sometimes-preliminary findings that are of interest to Earth scientists in academia, government, and industry; to land and resource managers; and to the general public. The reports presented in *Studies by the U.S. Geological Survey in Alaska* cover a broad spectrum of topics from various parts of the State (fig. 1), serving to emphasize the diversity of USGS efforts to meet the Nation's needs for Earth-science information in Alaska.

The chapters in this volume are organized under the topics Geologic Framework, Environment and Climate, and Hazards. This organization is intended to reflect the scope and objectives of current USGS programs in Alaska.

Geologic Framework studies provide background information that is the scientific basis for present and future Earth-science investigations. Dusel-Bacon and Harris report the discovery of several new fossil occurrences of late Paleozoic conodonts and radiolarians in the Seventymile and Yukon-Tanana terranes, and of Late Triassic conodonts in the Seventymile terrane in east-central Alaska. The Seventymile terrane in Alaska is equivalent to the Slide Mountain terrane in Canada; both are oceanic assemblages composed of fault-bounded slices of serpentinized periodotite, weakly metamorphosed mafic volcanic rocks, and Mississippian to Upper Triassic sedimentary rocks. Dusel-Bacon and Harris discuss the Upper Triassic rocks and both oceanic rocks of the Seventymile and Slide Mountain terranes and continental-margin rocks of the Yukon-Tanana terrane and ancestral North America.

In their first study, Dusel-Bacon and others present evidence that the mineralization at the Lead Creek Pb-Zn-Ag prospect, located in east-central Alaska, comprises an epigenetic vein and manto-style replacement deposit and that previous correlation with syngenetic, middle Paleozoic mineralization in the Finlayson Lake area of the Yukon Territory, Canada, is unwarranted.

In their second study, Dusel-Bacon and others report a new ion-microprobe U-Pb zircon age of 111±2 Ma for the Orthogneiss unit of the West Point Complex. They conclude that a previously determined age based on conventional U-Pb zircon analysis of a sample from the West Point orthogeneiss which gave an upper intercept of 671±34 Ma averaged several distinct isotopic populations and thus is geologically meaningless. If their interpretation of the mid-Cretaceous samples and the U-Pb zircon ages is correct, the maximum igneous crystallization age of the West Point orthogneiss and the minimum igneous crystallization age of the posttectonic Salcha intrusion imply that the mid-Cretaceous (synmetamorphic?) and posttectonic intrusion occurred during a narrow timespan between 113 and 111 Ma.

Oliver and Dusel-Bacon discuss a new structural analysis that has helped define a polyphase deformation history in ductilely deformed tectonites between the Chena and Salcha

[1] From 1975 through 1988, *Geologic Studies in Alaska* was published as a series of USGS Circulars, which were titled *The United States Geological Survey in Alaska: Accomplishments During 19xx*. From 1989 to 1994, the series was published as more formal USGS Bulletins. As a result of a reorganization in 1995 of USGS publications, the series is now being published as USGS Professional Papers.

Rivers in the Yukon-Tanana Upland of east-central Alaska. Kinematic analysis has identified widespread top-to-the-northwest and top-to-the-southeast shear senses and, in the structurally low Nasina assemblage, more local top-to-the-northwest fabrics. The top-to-the-northwest fabrics are interpreted to have resulted from Early Jurassic thrusting of allochthonous tectonites over the North American continental margin, and the top-to-the-southeast fabrics are attributed to mid-Cretaceous crustal extension that exhumed structurally lower rocks. The particularly well developed top-to-the-southeast fabrics around the West Point Complex may have formed during tectonic exhumation of the igneous and metamorphic complex, similar to the exhumation that is proposed for the Salcha River gneiss dome.

Amos and Cole's study of Tertiary volcanic rocks of the central Talkeetna Mountains provides new insight into the tectonomagmatic history of south-central Alaska. Although the timing and extent of subduction-related magmatism is poorly defined for the early Tertiary of south-central Alaska, geochemical analysis of volcanic rocks of the central Talkeetna Mountains indicates that subduction-related magmatic processes were important in the evolution of these rocks but that these rocks also lack some "typical" arc volcanic geochemical affinities. This trend is consistent with the interpretation that in western Alaska, from about 56 to 50 Ma, a transition occurred from subduction-related magmatism to postsubduction, possibly intraplate magmatism during which rocks typical of both environments were erupted. The mixed geochemical affinity of the volcanic rocks indicates that a similar transition occurred in south-central Alaska during Eocene time. Geochemical data suggest that a depleted mantle reservoir existed beneath south-central Alaska during the early Tertiary. This depleted mantle reservoir could represent the original composition of the upper mantle beneath the Wrangellia composite terrane, or it could have formed as a slab window beneath south-central Alaska after passage of a trench-spreading ridge-trench triple junction.

Sedimentologic and structural investigations by O'Neill and others along the trace of the Talkeetna thrust fault reveal the following relations: (1) the Kahiltna assemblage in the footwall of the Talkeetna thrust fault represents proximal submarine-fan deposits that were derived from strata exposed in the adjacent hanging wall of the fault; (2) the structure along the fault trace is that of minor thrust slices in the juxtaposed upper and lower plates, is nonpenetrative, and is restricted to within 20 to 50 m of the thrust fault. Lower-plate rocks containing rounded pebble to boulder clasts and macrofossils adjacent to the fault are undeformed. The proximal sedimentary relation between the footwall and hanging-wall rocks, along with the absence of well-developed penetrative-deformation fabrics, suggests that the Talkeetna Fault is not a major nappelike structure with tens of kilometers of tectonic transport, and so this individual fault zone does not mark a major tectonic-terrane boundary in south-central Alaska.

Regional mapping by Schmidt and Gamble, along with lithogeochemistry, suggests that many of the Tertiary plutonic rocks exposed in the northern Talkeetna Mountains belong to a "specialized" granite or granophile suite with high SiO_2 content. Major-, minor-, and trace-element geochemical analyses of fresh plutonic host rocks, altered rocks, and stream sediment suggest that the Clark Bar prospect has a potential to host granitoid Sn-Mo-Ag mineralization. Strongly altered rocks at Clark Bar are rich in Ag, Be, Ce, La, Li, Mo, Sn, and Zn, and some rocks are rich in Bi, Hg, and Sb. Associated Paleocene granitic rocks are SiO_2 rich and have a trace-element chemistry consistent with granophile or "specialized," S-type granites. Both the Clark Bar prospect and the regionally extensive Paleocene plutons have a moderate potential to host Sn-Ag-Mo and (or) W and rare-earth-element deposits.

Blodgett and others present evidence that Early Middle Devonian (Eifelian) gastropods from the Wadleigh Limestone in the Alexander terrane of southeastern Alaska demonstrate biogeographic affinities with those of central Alaska and Eurasia. They describe six species from a locality of the Wadleigh Limestone, most of which are conspecific or closely allied with coeval gastropod faunas from the Nixon Fork subterrane of the Farewell terrane of west-central Alaska and from the Livengood terrane of east-central Alaska. None of the species described is known from contemporaneous, miogeoclinal strata of western Canada, and none is recognized within coeval rocks of nonaccreted western North America. These close affinities suggest that the Alexander terrane, like the related Farewell and Livengood terranes, is of Eurasian origin.

Rohr and Blodgett describe a new Silurian gastropod, *Kirkospira glacialis* n.gen., n.sp., from the Upper Silurian part of the Willoughby Limestone of Glacier Bay, southeastern Alaska

(Rohr and Boldgett). The material examined, which was collected by the USGS in 1906 and 1917 from one of the two small islands immediately northeast of Willoughby Island, is part of a large-shelled molluscan facies that is observed on both Willoughby and Drake Islands. This Alexander terrane fauna is biogeographically most closely allied to other Late Silurian faunas from the Ural Mountains of Russian and the Farewell terrane of southwestern Alaska.

Stottlemyer and others discuss treeline biogeochemistry and dynamics in Noatak National Preserve. Their previous studies have focused on quantifying the sensitivity of the terrestrial ecosystem to global change, especially climate—in particular, soil temperature, moisture, and nitrogen availability—on ecosystem processes within an 800-ha-area watershed in a boreal biome. This study continues their previous work and updates their results from an intensive study conducted during 1997–98 on below-ground processes in taiga, tundra, and the taiga-tundra transition zone. They present data that in high-latitude ecosystems, changes in the carbon and nitrogen budgets are closely linked. The potential effects of seasonal changes on above-ground temperature and moisture may be partly offset by significant increases in below-ground moisture from thawing.

In two related studies, Harden and others and Manies and others discuss the effects of fire on soil temperature and vegetative regrowth for different soil-drainage classes in east-central Alaska. About 40 to 60 percent of the land surface in Alaska consists of poorly drained soils. Both studies present data on how fire affects the carbon storage of boreal forest and how this response varies with drainage types. Drainage type affects such factors as fire frequency and severity, vegetation recovery, and rates of decomposition. They suggest that large-scale patterns of fire are partly controlled by soil drainage and that ice-rich soil (zones of discontinuous permafrost) may be particularly “elastic” in their ability to store, release, and sequester carbon. Understanding variations in soil temperature, soil drainage, and fire history will give us a better understanding of the sensitivity of boreal regions to climate change.

Hildreth and others discuss Trident Volcano, which consists of four contiguous stratovolcanoes and several peripheral lava domes. Construction of the four principle edifices proceeded stepwise from northeast to southwest. The oldest stratovolcano, East Trident, had a brief eruptive lifetime around 143±8 ka. Trident I ended its activity by about 101±12 ka. The eruptive volume of 3 to 4 km^3 for the third stratovolcano, West Trident, was largely completed by 44±12 ka. After glacial dissection of the three Pleistocene cones, a fourth edifice, Southwest Trident, was constructed between 1953 and 1974. Reconstruction of the eroded edifices yields an estimated eruptive volume for the whole Trident group of 21±4 km^3. Averaged over 143±8 k. k.y., this output yields a long-term eruption rate of 0.11 to 0.18 km^3/k.y., far smaller than the rates calculated for neighboring Mageik and Katmai Volcanoes.

Waythomas and others present recent studies of the geology and eruptive history of Kanaga Volcano in the western Aleutian Islands of Alaska that have yielded new information about the timing of Holocene eruptions and an improved understanding of the evolution of the volcano. Their studies indicate that a major topographic feature on northern Kanga Island, a rim of a collapsed caldera, likely formed as the result of a northward-directed flank collapse which was not necessarily associated with a major eruption. Dacitic lapilli tephra deposits began accumulating on Kanaga Island about 11 ka, suggesting that most of the modern volcanic cone formed during Holocene time. At least 11 major tephra-producing eruptions of Kanaga Volcano have been documented. Tephra deposits on nearby Adak Island were believed to have been erupted from Kanaga Volcano throughout the Holocene. Tephrostratigraphic and chronologic data, however, indicate that only a few of the Adak tephra deposits are directly correlatable with eruptions of Kanaga Volcano, and so the source of the major pumiceous tephra deposits on Adak is uncertain.

Two bibliographies at the end of the volume list reports covering Alaska Earth-science topics in USGS publications during 2001 and reports about Alaska by USGS authors in non-USGS publications during the same period.

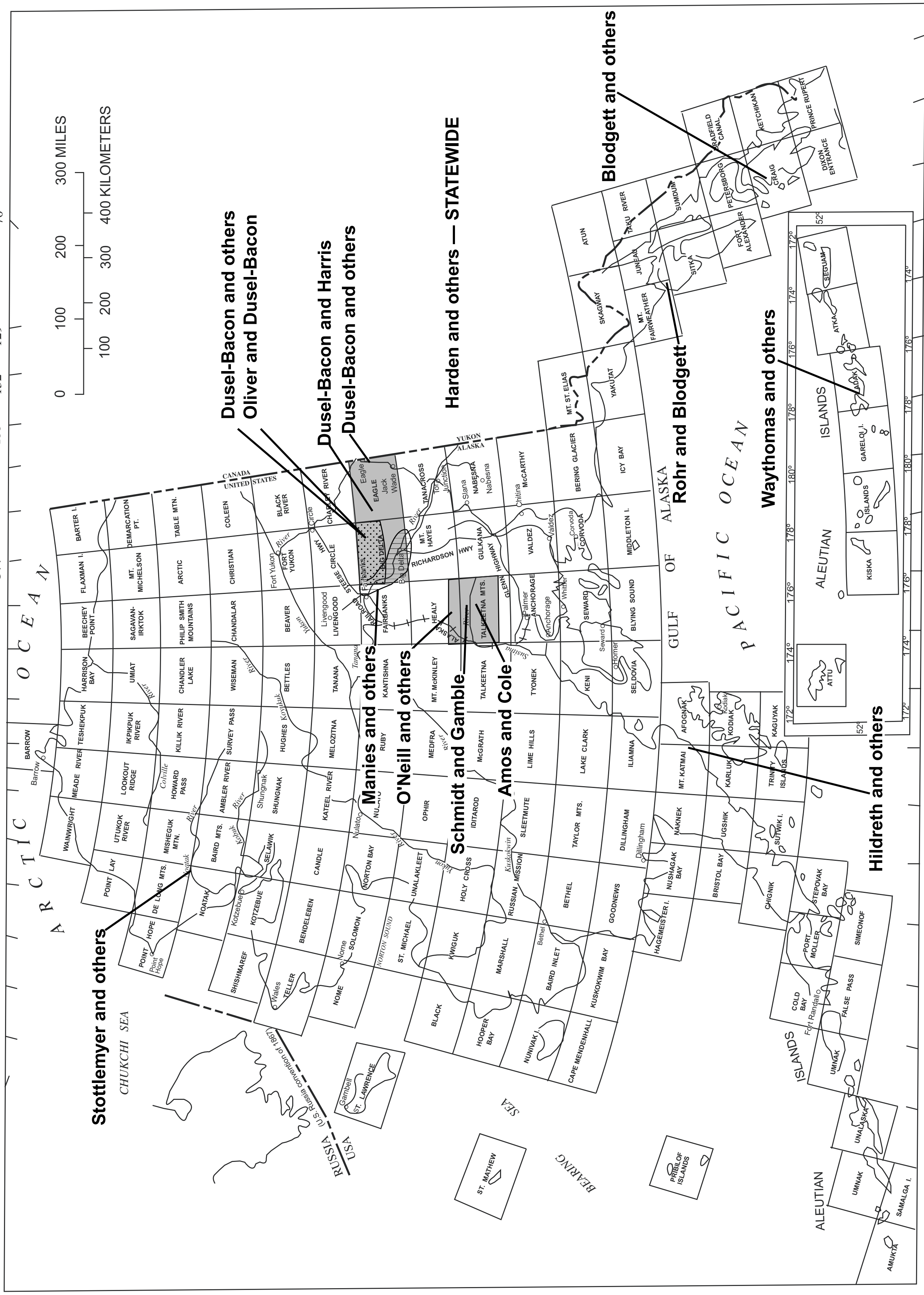

Figure 1. Index map of Alaska, showing 1:250,000-scale quadrangles and locations of study areas discussed in this volume.