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Abstract

During early exploratory reconnaissance of southwestern Alaska in the 1940s and 1950s, the term "Gemuk Group" was used to name a varied assemblage of sedimentary and volcanic rocks in southwestern Alaska. Throughout the 1950s and early 1960s, the name was broadly applied in the region; yet by the end of the 1960s, it was no longer in use, and later maps assigned the rocks originally in this unit to various informal units and, later, to various terranes. The name "Gemuk Group" is herein abandoned, and the rocks previously assigned to the Gemuk Group, a diverse and structurally complex assemblage, are renamed the "Togiak-Tikchik Complex."

Introduction

In the mid-1950s, Cady and others (1955) coined the stratigraphic term "Gemuk Group" to name a varied assemblage of sedimentary and volcanic rocks in southwestern Alaska. They designated the type locality as rocks exposed north of the middle "course" of the Gemuk River (Gemuk is a Yupik word for "small hill") in the Taylor Mountains 1:250,000-scale quadrangle and described other exposures of the Gemuk Group to the northeast in the Sleetmute quadrangle and to the northwest in the Russian Mission quadrangle (fig. 1). The Gemuk was defined during the waning stage of a wide-ranging exploratory-mapping effort conducted by the U.S. Geological Survey (USGS) starting in the 1890s to establish the framework geology of Alaska. The geologic maps produced by these exploratory surveys were primarily based on long crosscountry foot or boat traverses on which there was little opportunity to examine exposures off the path of travel or to revisit exposures. Many formal stratigraphic names were assigned to the geologic units described as a result of these expeditions, and some of these names remain in current use.

Recent efforts at compiling the geology of Alaska, particularly of southwestern Alaska, show that the name "Gemuk Group" is no longer widely used. The first of these recent compilations (Wilson and others, 1998) continued use of the term, but subsequent, more focused regional compilations have yielded additional information on the history and use of the name "Gemuk Group" as a stratigraphic and geologic unit. As a result, our premise here is that the name has outlived its usefulness and should be abandoned. Instead, the rocks traditionally assigned to the Gemuk Group represent a tectonic assemblage or collage and as a whole should therefore be referred to as a complex. Given the long use of the term "Gemuk Group," we further suggest that a new name be applied to reflect this revised status.

History: Definition and Use

As summarized in the USGS' *Lexicon of Geologic Names* (Keroher and others, 1966, p. 1488), the Gemuk Group was named after the Gemuk River. The type locality was designated as favorable exposures north of the lower middle course of the Gemuk River, southwest of the Kuskokwim River in the Taylor Mountains quadrangle in southwestern Alaska. The exposures extend northward about 15 mi (25 km) from the northwest side of the Gemuk River valley into the drainage basins of Atsaksovluk and Chikululnuk Creeks, and northeastward about 15 mi (25 km) into the headwaters area of the main fork of the Holokuk River in the Sleetmute quadrangle. The unit as defined consists of dense, dark, massive siltstone with interbeds of chert, volcanic rocks, limestone, graywacke, and breccia. According to Cady and others (1955), the volcanic rocks are chiefly andesitic in composition, although altered volcanic rocks mapped in the unit north of the Kuskokwim River were thought to have been originally basalt. The Gemuk Group was estimated to have an exposed thickness of 15,000 to 25,000 ft (4,600–7,600 m), and the massive siltstone was estimated to be 10,000 to 15,000 ft (3,100–4,600 m) thick in the vicinity of Cinnabar Creek. Nowhere is the base of the unit exposed, but the Gemuk Group was thought to conformably underlie sedimentary rocks of the Cretaceous Kuskokwim Group. Fossils of Late Triassic and Early Cretaceous age were collected from the unit, and Cady and others (1955) indicated that the rocks below the Cinnabar Creek section differ lithologically and may be older than Late Triassic. They suggested an age range of Carboniferous(?), Permian(?), Triassic, and Early Cretaceous for the Gemuk Group, based in part on tentative correlations with rocks mapped by Mertie (1938) to the south.

In their original publication, Cady and others (1955, p. 27) also suggested that the Gemuk Group extends southward to

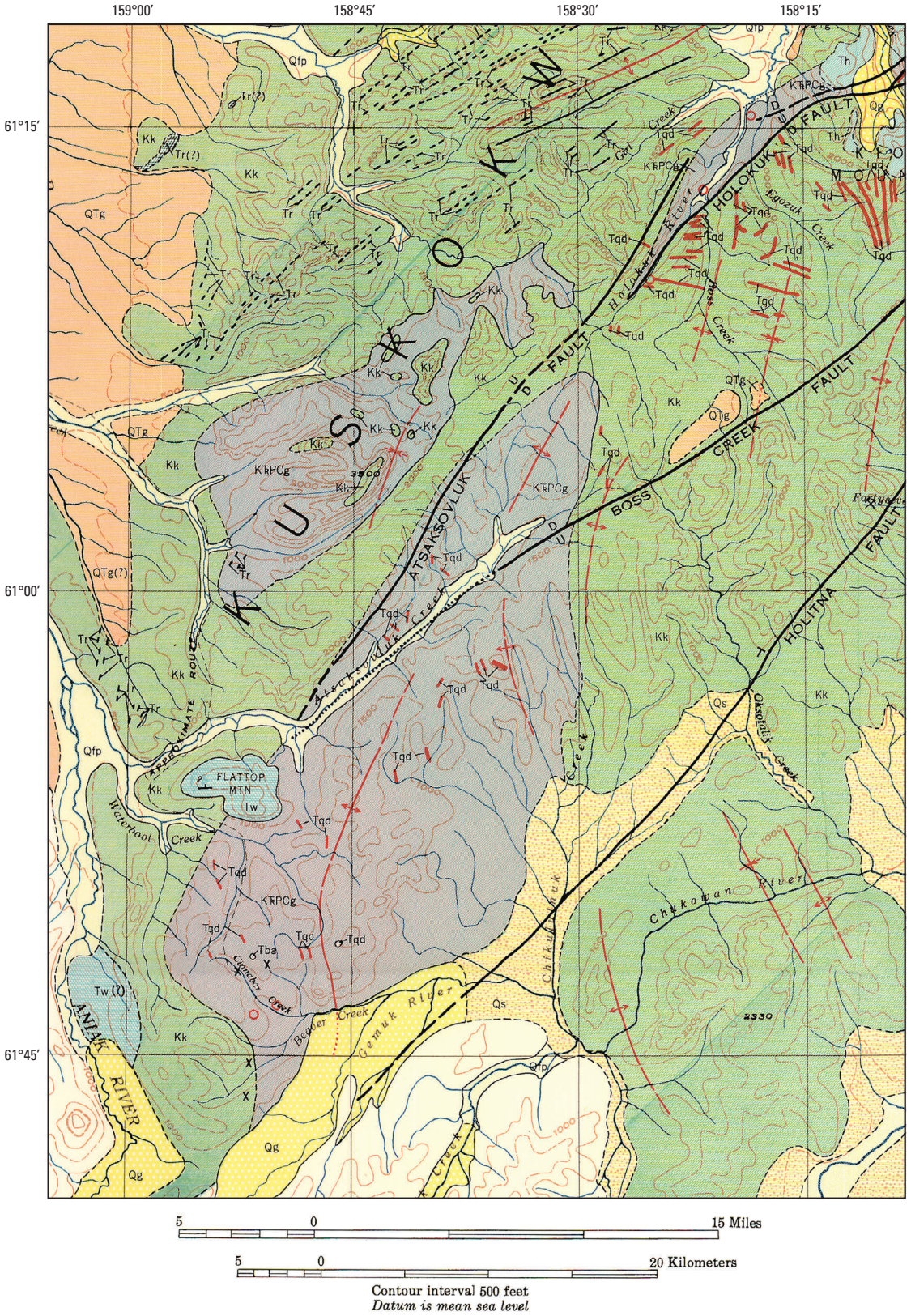


Figure 1. Geologic map of part of the Taylor Mountains 1:250,000-scale quadrangle, southwestern Alaska (see fig. 2), showing location of type area of the Gemuk Group as originally designated by Cady and others (1955). Area of inferred rocks of the Gemuk Group north of the Aniak River is not shown. Map units: Kk, Kuskokwim Group; KTPCg, Gemuk Group; Qfp, flood-plain deposits; Qg, glacial deposits; Qs, silt deposits; QTg, gravel deposits; Tba, basalt dikes; Th, Holokuk Basalt; Tqd, quartz diorite dikes; Tr, Tr(?), albite rhyolite dikes; Tw, Tw(?), Waterboot Basalt.

Chikuminuk Lake and probably farther southward. Sainsbury and MacKevett (1965), in their study of mercury deposits in southwestern Alaska, reported additional Triassic fossil collections in the Cinnabar Creek area. They also noted that part of the Cinnabar Creek section of the Gemuk Group probably is overturned and that, in general, the structure at Cinnabar Creek is significantly more complex than Cady and others (1955) had indicated.

Maps published subsequent to Cady and others (1955) for the Bethel, Russian Mission, Goodnews Bay, and Hagemeister Island quadrangles (Hoare and Coonrad, 1959a, b, 1961a, b) and compilations for the Taylor Mountains and Dillingham

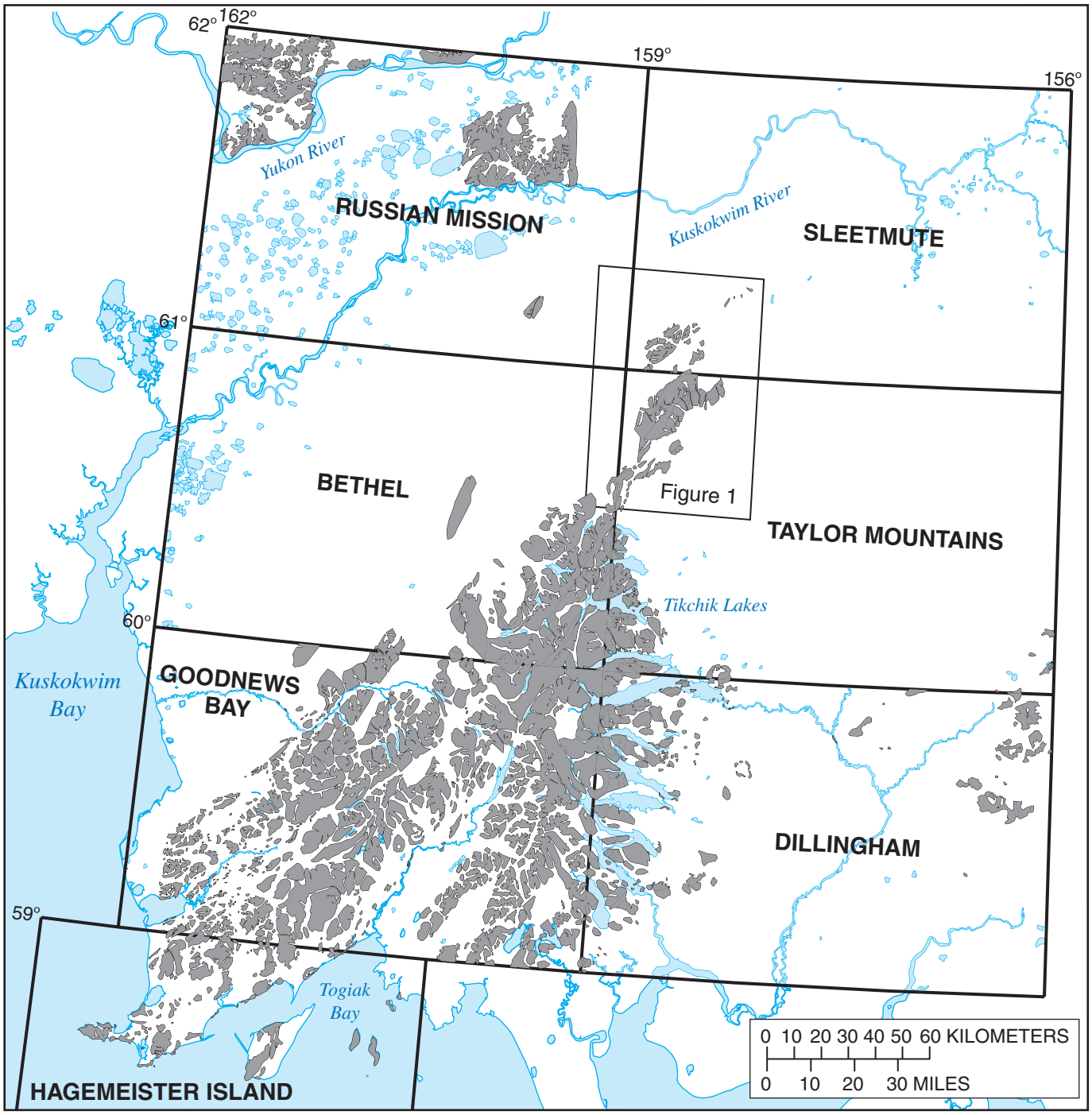


Figure 2. Southwestern Alaska, showing location of area over which previously (before 1969) the Gemuk Group was believed to extend. Rec-tangles, 1:250,000-scale geologic quadrangles.

quadrangles by J.N. Platt and E.H. Mueller (unpub. data, 1957) extended the known area of the Gemuk Group and provided additional information on the lithology and age of the unit. The unit had been subdivided on these maps into as many as three informal formations (for example, Hoare and Coonrad, 1959a). As a result, the Gemuk Group was given a vast areal distribution, extending more than 350 km across southwestern Alaska (fig. 2). Two important facts noted were that "* * * rocks of the Gemuk Group have yielded sparse fossils ranging in age from Carboniferous to Early Cretaceous. The rocks are complexly folded and faulted." (Hoare and Coonrad, 1961b) Goldfarb and others (1990) stated a revised age for the Gemuk Group of Triassic and Lower Cretaceous, for which they provided no explanation or justification. Additional fossil collections in the 1950s and 1970s (Hoare and Coonrad, 1961a, b; 1978; Hoare and Jones, 1981) showed that Cady and others' (1955) original suggestion that some of the rocks assigned to the Gemuk Group are at least as old as Carboniferous proved to be true; in fact, Hoare and Jones (1981) reported early Paleozoic radiolarians.

Implicit Abandonment

Yet, given the wide distribution of the unit as mapped, by 1969 and 1970 the term "Gemuk Group" was no longer in use. Field notes of 1969 and 1970 by W.H. Condon and J.M. Hoare no longer refer to the Gemuk Group, whereas Hoare's notes of 1953 do. Hoare was one of the coauthors of the report by Cady and others (1955), as well as responsible for mapping much of the area where the Gemuk Group was known. In their revision of the original maps of the Goodnews Bay and Hagemeister Islands and parts of the Bethel, Dillingham, and Taylor Mountains quadrangles, Hoare and Coonrad (1978) no longer used the name "Gemuk Group." Rocks shown on Hoare and Coonrad's (1959a) geologic map of the Bethel quadrangle as part of the subdivided Gemuk Group were assigned to two new informal map units (KJvs, MzPz) on Hoare and Coonrad's (1978) revised map. Rocks in the Goodnews Bay and Hagemeister Island quadrangles originally included in the Gemuk Group were assigned to these two new map units and other units varying widely in lithology; none of the unit descriptions mentions the Gemuk Group. However, the descriptions for all of these map units clearly include rocks that would have reasonably been assigned to the Gemuk Group in the past. Map unit Kts, consisting of tuff and sedimentary rocks, has yielded fossils of Early Cretaceous age (Hoare and Coonrad, 1978) from limy beds containing *Buchia* and tuffaceous chert containing radiolarians. The widespread map unit KJvs, which consists of volcanic rocks, including basalt and more abundant andesite, interbedded with thick sections of tuffaceous siltstone, tuffaceous chert, and massive or thin-bedded argillite, ranges in age from Middle Jurassic to Early Cretaceous but possibly includes Triassic and Permian rocks. Map unit Jk, informally referred to as the "Weary graywacke" (Hoare and others, 1975) and later as the "graywacke of Kulukak Bay" (Hoare and Coonrad, 1978), consists of quartz- and plagioclase-rich graywacke to quartz-poor volcanic wacke described as turbidites by Box (1985). Map unit MzPz, more closely associated with the previously mapped Gemuk Group, is lithologically similar to the Gemuk Group as originally defined but also includes conglomerate and limestone. Although each of these rock packages was assigned to the Gemuk Group as originally defined, subsequent mapping and understanding of the regional geology has led to their redefinition as distinct map units. The implicit message is that the Gemuk Group and its subdivisions no longer proved useful in mapping, a not uncommon occurrence for units defined during the exploratory phase of geologic mapping in Alaska. Similar terms subsequently abandoned after wide use include the Birch Creek Schist of interior Alaska and the Shaktolik Group of west-central Alaska. The name "Holitna Group," also originally defined by Cady and others (1955), has also been suggested for abandonment as a better understanding of those rocks has developed (see Adrain and others, 1995; Blodgett and Wilson, 2001).

During the course of studies in southwestern Alaska, Box and others (1993) published a revised map of the Bethel quadrangle and the southern part of the Russian Mission quadrangle. Their map is strongly terrane based; however, the critical point here is that they assigned rocks previously mapped as part of the Gemuk Group to multiple distinct terranes. They did not use the name "Gemuk Group" for a geologic unit, another implicit message suggesting that the unit is no longer useful for mapping purposes. On Box and others' (1993) map, the rocks assigned to map units KJvs and MzPz of Hoare and Coonrad (1978) are reassigned to multiple informal geologic units in two terranes: (1) melange (unit TrPzm), marine sandstone, shale, limestone, and conglomerate (unit TrDs), and massive volcanic and volcaniclastic rocks (unit MDv) of the Tikchik terrane; and (2) phyllite and chert (unit JTrp), pillow basalt and minor interbedded chert (unit Trb), marine volcaniclastic sandstone, conglomerate, shale, and interbedded tuff (unit Kvs), argillite and tuffaceous chert (unit KJc), marine volcaniclastic sandstone, conglomerate, and argillite (unit Jvs), and marine arkosic sandstone and argillite (unit Ja) of the Togiak terrane. Few stratigraphic ties have been established between these units, and so we have no justification for assigning them to a single stratigraphic unit (the Gemuk Group). The rocks assigned to the Gemuk Group in the Russian Mission quadrangle by Cady and others (1955) and Hoare and Coonrad (1959b) were assigned to a unit of andesitic and basaltic lava flows and marine epiclastic rocks of the Nyac terrane by Box and others (1993) and included in the enigmatic Portage sequence by Decker and others (1994), who also no longer referred any rocks to the Gemuk Group. The only explicit mention of the Gemuk is to rocks in their "Portage sequence" as having been originally mapped as "part of the undivided Gemuk Group" (Decker and others, 1994, p. 298). Here again, the implicit message is that the term "Gemuk Group" has fallen out of use.

The Togiak-Tikchik Complex—Modern Usage

As mentioned above, recent efforts at compiling the geology of Alaska have brought renewed attention to the Gemuk Group. Wilson and others (1998) used the term without close examination of its past usage or broader definition. Subsequent, more focused work in southwestern Alaska has yielded additional information on the history and use of the term "Gemuk Group" as a stratigraphic and geologic unit name. Miller and others (2004) have suggested that the name be restricted in its use to the type area and a limited extent northward, significantly less than as originally suggested by Cady and others (1955) or as mapped by Hoare and Coonrad (1959a, b, 1961a, b). New field data and fossil collections by Miller and others (2004) in the Sleetmute quadrangle do suggest that a distinctive geologic unit is present. However, these new data do not extend the unit southward to include the full type area of the Gemuk Group, and the suggestion that these "contiguous rocks" represent a stratigraphic unit is premature, particularly given the structural complexities reported by Sainsbury and MacKevett (1965) and indicated for the rest of the rocks traditionally mapped as part of the unit (Hoare and Coonrad, 1978; Box, 1985; Box and others, 1993; Decker and others, 1994). Sainsbury and MacKevett (1965), in contrast to Cady and others (1955), suggested that the stratigraphic column section of the Gemuk Group in the Cinnabar Creek area (within the type area) is a structurally complex rather than homoclinal section exposing 10,000 to 15,000 ft (3,000–4,600 m) of sequence. They recognized a major fold repeating a unit of fossiliferous limestone, a general southeastward convergence of beds, and infaulting of a unit of graywacke, siltstone, and volcanic rocks. They also showed the Gemuk Group as continuing southward, into an area mapped by Cady and others (1955) as the Kuskokwim Group. This revision results in a better match with Hoare and Coonrad's (1959b) map of the Bethel quadrangle.

On the basis of information presented by Sainsbury and MacKevett (1965), the Gemuk Group in the type area does not appear to be a coherent stratigraphic unit. Box (1985) and Box and others (1993) assigned rocks traditionally part of the Gemuk Group to multiple tectonostratigraphic terranes. A current compilation for the Taylor Mountains and Dillingham quadrangles, using the maps of J.N. Platt and E.H. Mueller (unpub. data, 1957), the field notes of J.M. Hoare and W.H. Condon (unpub. data, 1969, 1970), and more recent data, provides ample evidence that a wide variety of rocks have been included in the Gemuk Group as originally defined. Rock types ranging from siltstone and sandstone to abundant chert of many varieties, volcanic rocks, and limestone of various ages have all been assigned to the Gemuk Group. Fossils ranging in age from early Paleozoic to Early Cretaceous have been collected from these rocks. Faulting and folding characterize many parts of the unit, some of which clearly represent melange. As a result, we propose that the term "Gemuk Group" does not represent a coherent stratigraphic unit, has outlived its usefulness in fostering understanding the geology of southwestern Alaska, and should therefore be abandoned. However, in contrast to the suggestion by Box and others (1993) or Decker and others (1994) that the various parts of the Gemuk Group represent distinctive terranes, we do not believe that mapping to date is sufficient to clearly distinguish terranes (fig. 3). The terrane definitions, names, and boundaries used by Box and others (1993) and Decker and others (1994) vary significantly, and although Box (1985) provided some information regarding linkages between subterranes in southwestern Alaska, much uncertainty remains regarding which rocks belong to which terrane.

On their maps, Hoare and Coonrad (1959b) and Box and others (1993) show major throughgoing faults cutting the region, including the Togiak-Tikchik Fault cutting through map unit KJvs of Hoare and Coonrad (1978) or separating the Togiak and Tikchik terranes of Box and others (1993), or, alternatively, cutting through the Hagemeister subterrane of the Togiak terrane (Decker and others, 1994). This fault, long thought to be an extension of the Denali Fault system of south-central Alaska, has little demonstrated offset in southwestern Alaska, certainly nothing approaching the hundreds of kilometers of offset recognized on the Denali Fault in south-central Alaska.

As defined here, the Togiak-Tikchik Complex generally includes rocks mapped as part of the Gemuk Group by Cady and others (1955), J.N. Platt and E.H. Mueller (unpub. data, 1957), Hoare and Coonrad (1959a, b, 1961a, b), and Sainsbury and MacKevett (1965). The name "Togiak-Tikchik complex" is derived from two geographic features that fall within the outcrop area of the unit. The extent and lithologic diversity of the unit are such that no single geographic locality can encompass a representative section, and so we have hyphenated names derived from two localities: Togiak Bay on the southwest and the Tikchik Lakes near the northeastern limit of the outcrop area. Definition of a type area or locality for the Togiak-Tikchik Complex is difficult, owing to limited mapping within the outcrop area. However, a representative group of localities would reasonably include the original type area of the Gemuk Group along the lower Gemuk River, including the Cinnabar Creek area, as well as the Tikchik Lakes area in the southwestern part of the Taylor Mountains quadrangle. Although some locally distinct lithologic packages can be mapped and identified within the unit, overall, stratigraphic ties between the various lithologic packages have yet to be established. The name "Togiak-Tikchik Complex" is mainly proposed because the Gemuk Group, as originally defined, was a stratigraphic unit, whereas the Togiak-Tikchik Complex is a structural collection of diverse lithologic packages that probably do not have a coherent stratigraphy and include a melange facies.

The maps by J.N. Platt and E.H. Mueller (unpub. data, 1957), and Hoare and Coonrad (1959a, b, 1961a, b) subdivided the originally undivided Gemuk Group into lithologic packages; however, subsequent mapping has not continued use

of those subdivisions. Rocks included in the Togiak-Tikchik Complex, as defined here, range in age from confirmed early Paleozoic through Carboniferous, Permian, Triassic, Jurassic, and Early Cretaceous. Permian fossils are widely distributed, as are Early Cretaceous fossils. Certainly, some of the rocks included in the complex will ultimately be found to correlate with well-defined units elsewhere. Some rocks originally included in the Gemuk Group have been shown to more properly belong to the Kuskokwim Group (see Hoare and Coonrad, 1978), and some rocks assigned to the Kuskokwim Group should have been assigned to the Gemuk Group (Sainsbury and MacKevett, 1965). Precise definition of the boundary or

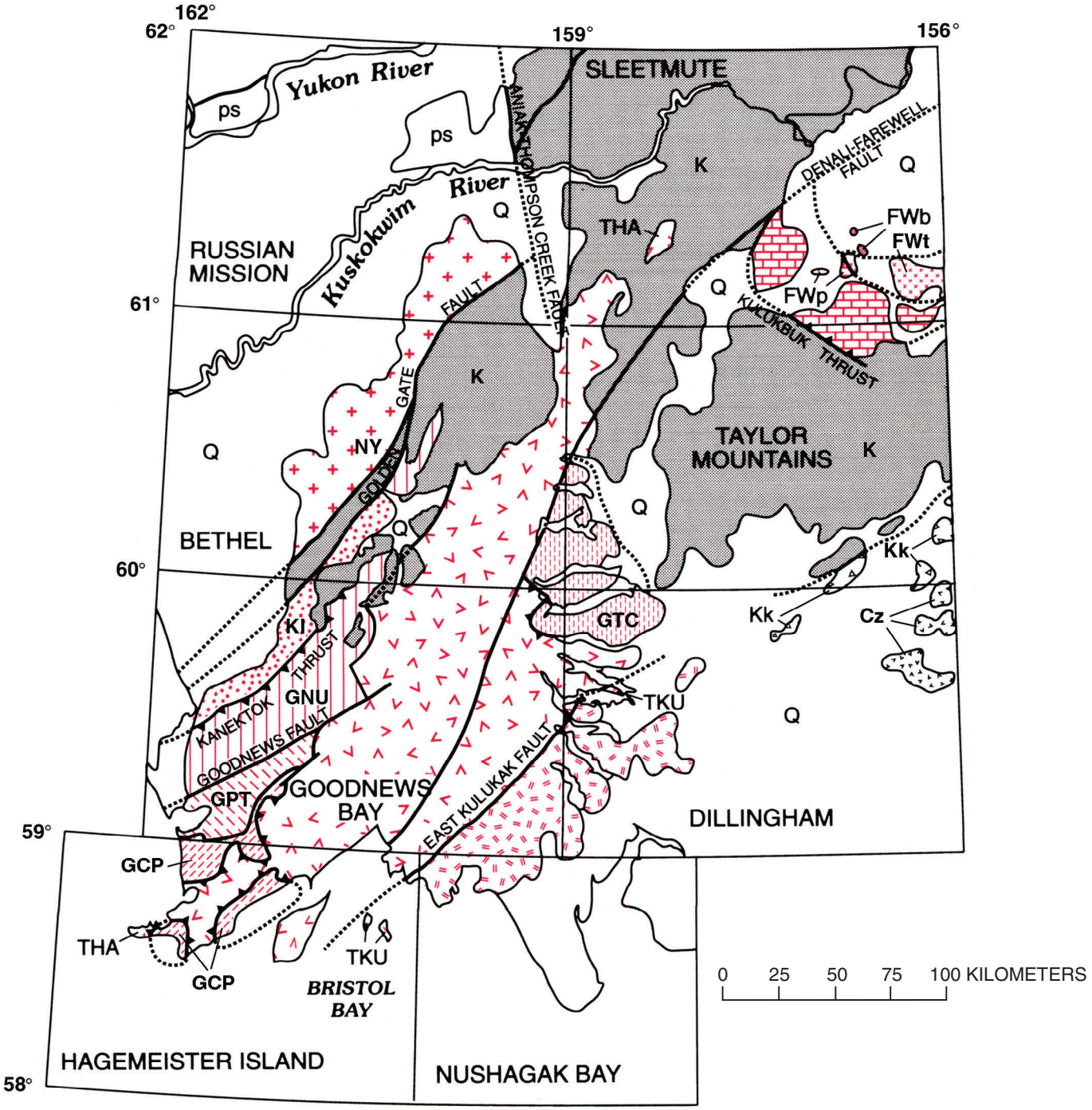
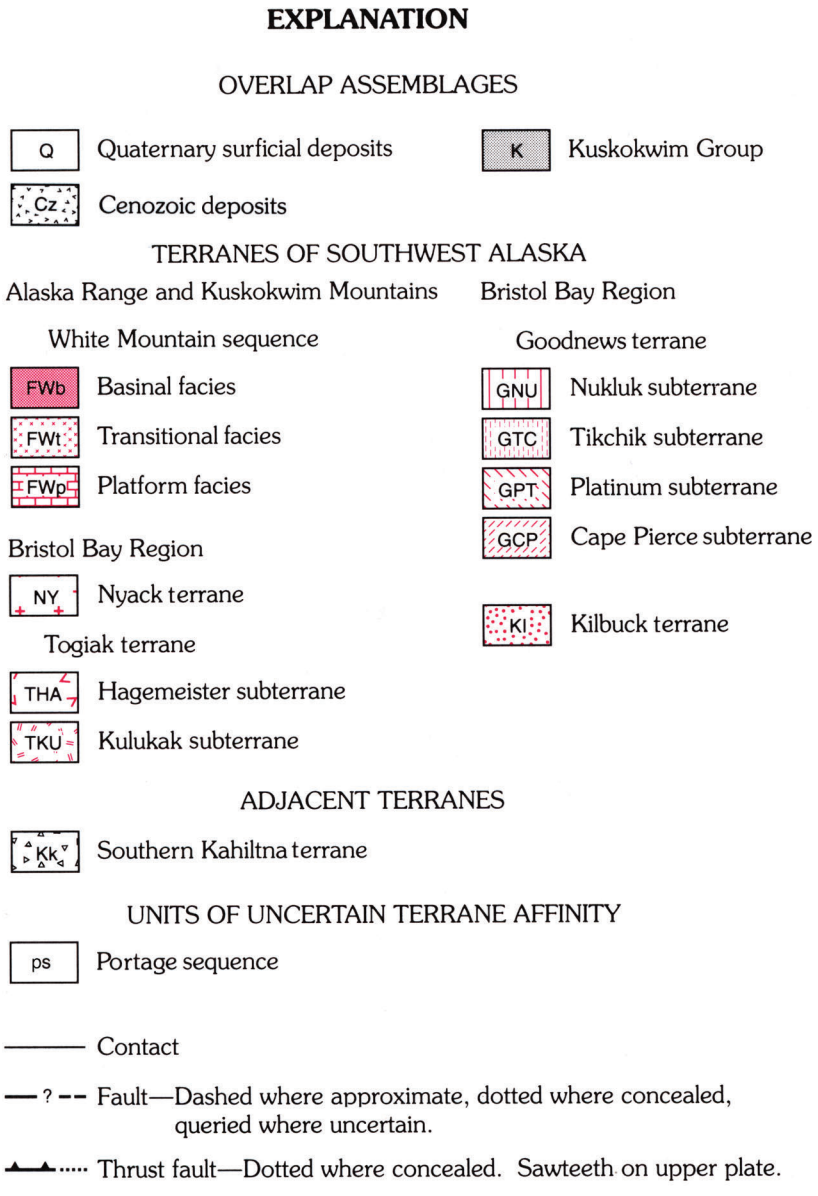


Figure 3. Tectonostratigraphic-terrane map of southwestern Alaska, showing terranes to which rocks of the Gemuk Group were previously (before 1969) assigned. Rectangles, 1:250,000-scale geologic quadrangles. Modified from Decker and others (1994).

areal extent of the Togiak-Tikchik Complex is impossible, owing to the inadequacy of geologic mapping in the region. Nonetheless, a reasonable approximation of its extent is shown in figure 2 as the limits of the Gemuk Group as mapped by Hoare and Coonrad (1959a, 1961a, b) in all but the Russian Mission quadrangle. Within a more modern context, the Togiak-Tikchik Complex includes the Togiak terrane and the Nukluk and Tikchik subterranes of the Goodnews terrane of Decker and others (1994) and may also properly include the Portage sequence of Decker and others (1994), rocks of which were included in the original Gemuk Group by Cady and others (1955). W.W. Patton (written commun., 2004) has suggested that the Portage sequence of Decker and others (1994) should be assigned to the combined Angayucham-Tozitna terrane of west-central Alaska.

Conclusion

The name "Gemuk Group" is herein abandoned, and the rocks previously assigned to the Gemuk Group, a relatively contiguous, early Paleozoic to Early Cretaceous, lithologically diverse and structurally complex assemblage of rocks in the Sleetmute, Taylor Mountains, Bethel, Russian Mission, Goodnews Bay, and Dillingham quadrangles, are renamed the "Togiak-Tikchik Complex" to better reflect the outcrop area and the nature of the unit as a structural juxtaposition of diverse stratigraphic units. Although separation of these rocks into tectonostratigraphic terranes has been attempted numerous times, uncertainties have yielded a varying assemblage of terranes (Jones and others, 1981; Box, 1985; Box and others, 1993; Decker and others, 1994). Each of these efforts has



resulted in some lithologic packages (Paleozoic chert, Permian limestone) being divided among terranes. Until better mapping, chemistry, and age control exist, we suggest the name "Togiak-Tikchik Complex," and its possible future subdivisions, as the best way to refer to these rocks. Although the Togiak-Tikchik Complex remains an enigmatic unit in southwestern Alaska, its recognition as a structural collage rather than a distinct stratigraphic entity is important in developing an understanding of these rocks and the geology of southwestern Alaska.

Acknowledgments

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