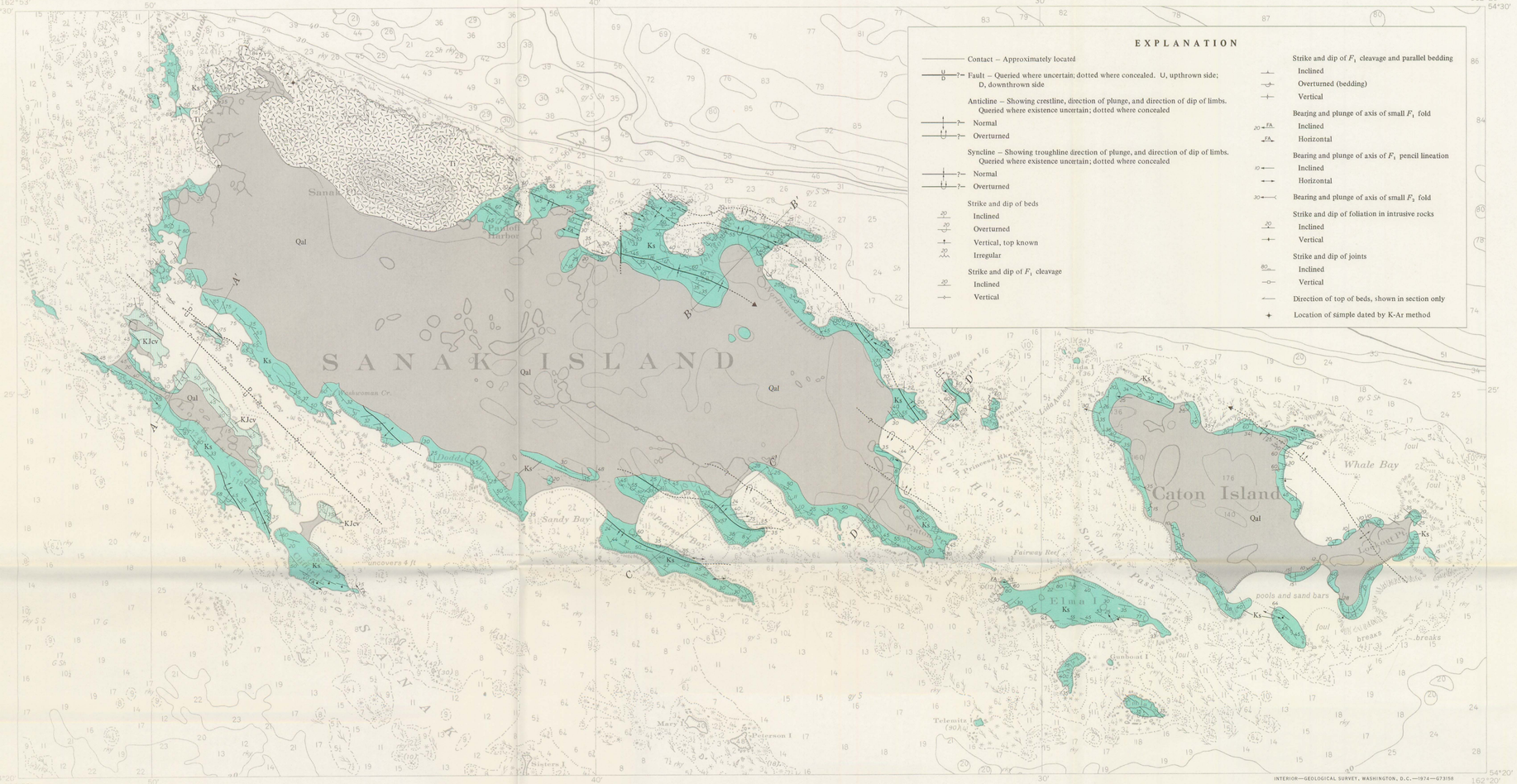
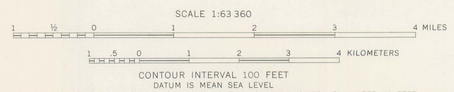


Base from U.S. Coast and Geodetic Survey Chart 8701

Geology by J. C. Moore and H. M. Kelsey, 1970

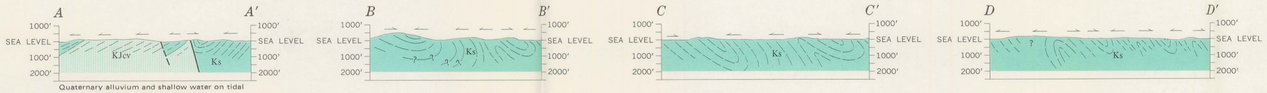


SCALE 1:63 360

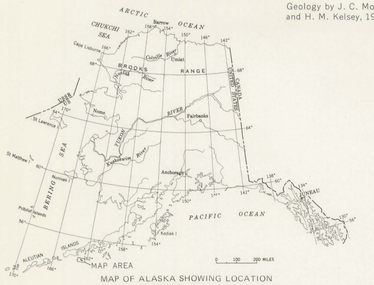
1 ½ 0 1 2 3 4 MILES

1 .5 0 1 2 3 4 KILOMETERS

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FATHOMS—DATUM IS MEAN LOWER LOW WATER IN FEET



Quaternary alluvium and shallow water on tidal flats not show in cross sections



MAP OF ALASKA SHOWING LOCATION OF SANAK ISLANDS

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1974—G73158

GEOLOGIC AND STRUCTURAL MAP OF THE SANAK ISLANDS, SOUTHWESTERN ALASKA

By
J. Casey Moore

1974

CORRELATION OF MAP UNITS

	Qal	QUATERNARY
	Ti	TERTIARY
Upper Cretaceous	Ks	CRETACEOUS
Lower Cretaceous or Jurassic	KJcv	CRETACEOUS OR JURASSIC

DESCRIPTION OF MAP UNITS

Qal — ALLUVIUM – Gravel, sand, silt, and clay, including deposits of beaches, bars, spits, streams, and marshes

Ti — INTRUSIVE ROCKS – Predominantly light- to medium-gray, medium- to fine-grained biotite granodiorite, hypidiomorphic granular texture. Contacts are sharply discordant to bedding, F_1 cleavage, and F_1 folds. Minor hornfelsing developed at contacts

Ks — SHUMAGIN FORMATION – Medium-light-gray to medium-dark-gray, medium- to very fine-grained, highly indurated sandstone, weathering to lighter grayish, greenish, or brownish hues. Interbedded grayish-black mudstone weathering to lighter grayish and brownish hues. Sandstone forms massive units 1-20 m thick or base of graded beds generally less than 2 m thick. Dragmarks and flute casts occur on soles of massive sandstone and graded beds. Sandstone locally contains interformational breccias composed of mudstone clasts. Formation includes interbedded sequences of thin (average 10 cm) mudstone-rich graded beds and rare andesitic and basaltic dikes

KJcv — CHERT AND VOLCANIC SEQUENCE – Reddish-brown, light-gray, and grayish-green bedded chert; dark-greenish-gray pillow lavas and tuffs, thin (5-10 cm) medium-gray, medium- to fine-grained sandstone interbedded with dark-gray mudstone

GEOLOGIC SUMMARY

INTRODUCTION

This map is a product of detailed sedimentologic and structural investigations of Upper Cretaceous turbidites of Shumagin-Kodiak Shelf, Alaska (Moore, 1972, 1973a, 1973b). Fieldwork in the Sanak Islands was carried out over six weeks during May-June 1970. Traverses were concentrated along shoreline exposures; outlying islands were reached by skiff. Adverse weather conditions and rough seas prevented study of Sisters, Mary, and Peterson Islands of the Sanak group.

To date, the only published geological work in the Sanak Islands is by Burk (1965). During his investigations Burk correctly identified the main lithologic units, determined their structural trend, and first correlated the abundant sandstone and mudstone with those exposed in the outer Shumagin Islands.

This map is part of a thesis submitted to Princeton University in partial fulfillment of the requirements for a Ph.D. degree. The fieldwork was supported by the U.S. Geological Survey, Mobil Oil Corp., Atlantic Richfield Co., and Princeton University. C. A. Burk and F. B. Van Houten gave generous assistance throughout this study. Discussions with George Plafker and George Moore greatly extended the author's perspective of Alaskan geology. Harvey Kelsey provided amiable companionship and excellent field assistance. Thanks are offered to Bill Hollingsworth, Jim Moritz, and Chris and Julia Gundersen for unselfish assistance in the logistics of this investigation. R. H. Detterman and S. H. B. Clark provided thoughtful reviews, which significantly improved this map.

STRATIGRAPHY AND PETROLOGY

CHERT AND VOLCANIC SEQUENCE

The oldest rocks in the Sanak Islands are a chert and volcanic sequence that conformably underlies the Shumagin Formation. A depositional contact between these two units is indicated by parallel attitudes above and below the boundary and by large (50 cm long) sedimentary inclusions of chert in the overlying massive Shumagin sandstone. The base of the chert and volcanic sequence is not known. Maximum exposed thickness is about 250 m. No identifiable fossil remains were found in the sequence; it must predate the Shumagin Formation (Upper Cretaceous) and is presumably of Jurassic or Early Cretaceous age. The chert and volcanic sequence is lithologically identical to parts of the Triassic Uyak Formation, Kodiak Island (Moore, 1969).

Chert, pillow lava, sandstone, and mudstone, variously interbedded, make up all exposures of the chert and pillow lava sequence. The chert occurs in 10- to 15-cm-thick beds and is highly fractured and recrystallized with rare ghosts of radiolaria. Microscopically, pillow lavas of the chert and volcanic sequence show an intersertal texture of oligoclase phenocrysts in a highly altered matrix. These rocks are apparently altered basalt. The sandstone is similar in macroscopic appearance to the basal sandstone of the thin graded beds of the Shumagin Formation but not as coarse as the massive sandstone of the Shumagin.

SHUMAGIN FORMATION

The Shumagin Formation was named by Burk (1965, p. 63-71) for dark-gray sandstones, black shales, and siltstones on Nagai and adjacent islands in the outer Shumagin Islands.

In the Sanak Islands, the Shumagin Formation is assumed to be Late Cretaceous in age on the basis of lithologic correlation with fossiliferous rocks in its type area (Jones and Clark, 1973). The conformable contact with the chert and volcanic sequence forms the base of the Shumagin Formation; the top of the formation is not exposed. Lack of marker beds and complex deformation preclude accurate estimates of thickness, although a relatively homoclinal section 1,500 m thick is exposed along the northwest shore of Sanak Island.

The sandstone of the Shumagin Formation is volcanic arenite with slightly less than 10 percent matrix (Williams and others, 1954). Framework grain compositions (fig. 1) are similar to those of correlative rocks in the outer Shumagin Islands. The average composition of 20 samples of sandstone from the Sanak Islands is 11 percent quartzose grains, 30 percent feldspar, and 59 percent lithic fragments, of which 98 percent are of volcanic origin. Potassium feldspar accounts for only 3 percent of the total feldspar, and chert makes up 21 percent of the quartzose grains.

INTRUSIVE ROCKS

The Sanak pluton is a dateable rock-stratigraphic unit which places a time limit on the occurrence of the major (F_1) folding. The petrology of this pluton remains essentially unstudied; however, its composition was crudely estimated from one stained slab and field inspection of hand specimens. A potassium-argon age determination on a sample from Murphy Cove, west of Sanak Harbor, yielded a date of 59.9 ± 1.8 m.y. (Tertiary) for the pluton (M. A. Lanphere, written commun., March 1972).

A brief study of contact relations shows that the pluton is strongly discordant to F_1 structures in the Pavlof Harbor region. Adjacent to the contacts, the Shumagin Formation includes mottled sandstone and spotted phyllite. Small felsitic dikes and phyllite locally observed in an area between Pavlof to Northeast Harbor suggest that the Sanak pluton may be elongated and may underlie this area at a shallow depth.

STRUCTURAL GEOLOGY

The structural geology of the Sanak Islands is dominated by major early folds; later folds and faults are much less pervasive. The west-northwest trend and south-southwest overturning of the major (F_1) folds are reflected by the attitude patterns on the map, the cross sections, and the stereographic projections (fig. 2). On Sanak Island, many F_1 folds are defined by alternate upright and overturned stratigraphic sections. Frequently, the axial zone of these folds is characterized by a series of minor anticlines and synclines, not a discrete fold axis (for example, the overturned syncline south of Peterson Bay). Small-scale folds are often disrupted; minor thrusting may have occurred parallel to the axial surfaces of some larger folds. Whether or not the major structures are interpreted as overturned folds or thrusts, the sense of shear required is the same. These features are shown as overturned folds on the cross sections.

The F_1 folds are characterized by axial-plane slaty cleavage. In a few places, the cleavage fans in a divergent sense (Ramsey, 1967, p. 405), although the overall correlation of axial planes and cleavage is excellent (fig.2). Cleavage may show all stages of development from subtle orientation of clay minerals across bedding to pronounced slaty parting. The intersection of cleavage and bedding may form a crude pencil lineation. Because of limited space, most measurements of fold axes, lineations, and cleavage are not included on the map. All data on minor structural features are compiled in figure 2.

The F_2 fold structures are much smaller and much less pervasive than the F_1 folds. We were unable to trace any map-scale F_2 folds. Criteria for distinguishing F_2 folds include folding of F_1 cleavage and kink or chevron style. Deformation of the F_2 folds postdate F_1 structures. The F_1 or F_2 affinity of a few folds could not be determined.

Pervasive faulting and shearing characterize the rocks of the Sanak Islands. However, the monotonous nature of the stratigraphic units prevents tracing of faults by a given formation. The small unnamed island (section *A-A'*) between Long and Sanak Islands is an uplifted, tilted fault block. On the northeast side of the unnamed island, the chert and volcanic sequence is uplifted along a steep fault. On the southwest side, massive sandstone of the Shumagin Formation conformably overlies the chert and volcanic sequence, and both units dip 55° to the southwest. On the basis of occurrence, the entire chert and volcanic exposure on Long and Clifford Islands is interpreted as an uplifted, tilted fault block. The major fault (or faults?) apparently underlies the linear tidal flat between Long Island and the unnamed island. It is also possible that the chert and volcanic sequence is interbedded within the Shumagin Formation and that no major fault exists. However, this interbedding is unlikely because none of the sandstone associated with the chert on Long and Clifford Islands resemble the distinctive massive sandstone of the Shumagin Formation.

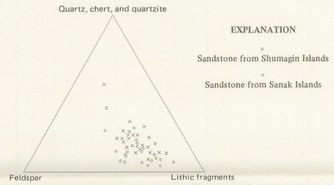
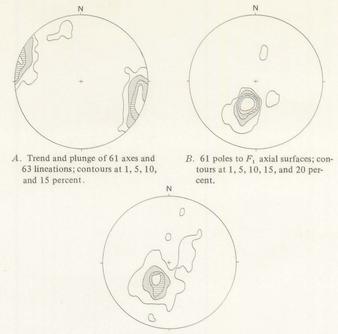


Figure 1. Comparison of framework grain compositions of sandstone of the Shumagin Formation from the Shumagin and Sanak Islands.



A. Trend and plunge of 61 axes and 63 lineations; contours at 1, 5, 10, and 15 percent.

B. 61 poles to F_1 axial surfaces; contours at 1, 5, 10, 15, and 20 percent.

C. 194 poles to slaty cleavage; contours at 1, 5, 10, and 15 percent.

Figure 2. Equal-area lower-hemisphere projections of F_1 fabric elements.

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For sale by U.S. Geological Survey, price 75 cents