CHAPTER 2

BRIEF OVERVIEW OF GEOLOGIC MAPPING OF THE MIDDLE JURASSIC CHINITNA FORMATION AND UPPER JURASSIC NAKNEK FORMATION IN THE TILTED HILLS, INISKIN PENINSULA, COOK INLET, ALASKA

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The Tilted Hills extend for approximately 30 km along the southeastern Iniskin Peninsula (fig. 2-1) and constitute a physiographically prominent, chiefly northeast-trending belt of peaks, ridges, and areally extensive flat-irons (fig. 2-2). Outcrops in the Tilted Hills dominantly consist of Chinitna and Naknek Formations, permitting examination of latest Middle to Late Jurassic forearc basin strata of Cook Inlet (fig. 2-3). Through detailed documentation of the distribution of lithostratigraphic units in the area we aim to improve our understanding of Jurassic depositional systems in this prolific hydrocarbon-bearing

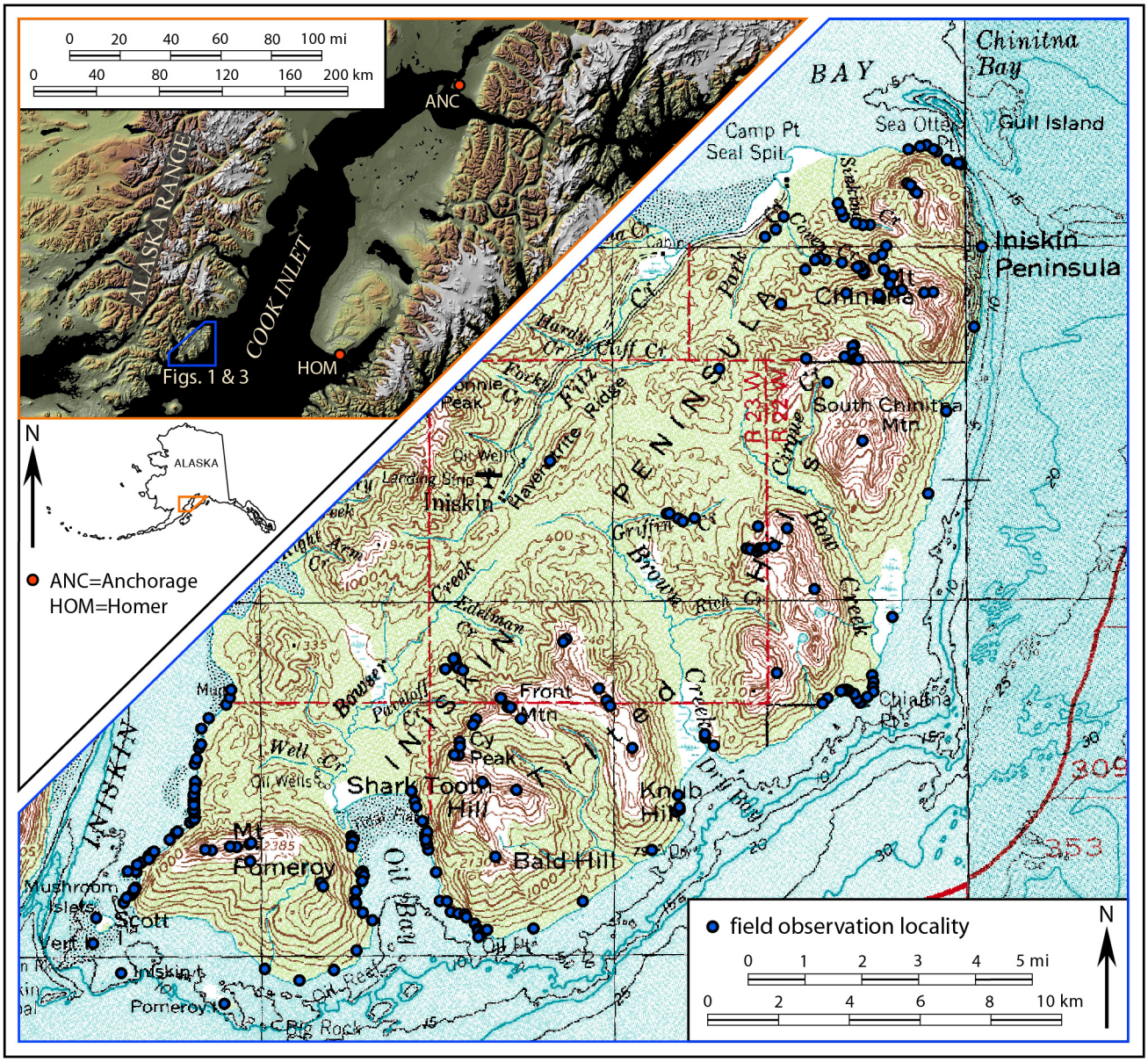

Figure 2-1. Index map of the Iniskin Peninsula area. Detailed observations were made at more than 300 localities during four field seasons in the area. Topographic base map from portions of U.S. Geological Survey Iliamna and Seldovia 1:250,000-scale quadrangles; shaded-relief image modified after U.S. Geological Survey Elevation Data Set Shaded Relief of Alaska poster.

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Figure 2-2. View eastward of the Tilted Hills, Iniskin Peninsula, showing the Chinitna and Naknek Formations, with the east shore of Iniskin Bay in the foreground. The largest flat-irons (for example, photo-center) occur in the Pomeroy Arkose Member and the lower part of the vegetated slope below corresponds to the Chinitna Formation.

basin, including key parameters such as accommodation and sediment supply. This brief report presents a simplified version of our 1:63,360-scale geologic map of the Tilted Hills (fig. 2-3) and summarizes some of the mapping criteria that were employed during the 2013 field season. A more thorough summary of our field observations is in the process of being published (Herriott and Wartes, in press [2014]).

The Chinitna and Naknek Formations in the Tilted Hills constitute an approximately 2,000-m-thick section of dominantly marine sandstone and siltstone, with subordinate conglomerate (fig. 2-3). Six mappable members are largely defined by their lithologic character (Detterman and Hartsock, 1966) and are inferred to record sedimentation from fan delta to basin floor depositional environments (LePain and others, 2013; Wartes and others, 2013; Herriott and Wartes, in press [2014]).

The upper Middle Jurassic Tonnie and Paveloff siltstone members (Chinitna Formation) are generally recessive units, with the latter typically exhibiting a slightly more resistant weathering profile (fig. 2-4). Additionally, the two Chinitna members can generally be distinguished by their colors: the Tonnie is characteristically medium-brown-weathering, whereas the Paveloff is chiefly dark-gray-brown- and gray-green-weathering (fig. 2-4). Both of these siltstone units are locally sandy, and Wartes and Herriott (this volume) report an oil-stained locality along Chinitna Bay's south shore (fig.2-1) in the locally well-developed basal sandstone section of the Paveloff.

The basal members of the Upper Jurassic Naknek Formation are the Chisik Conglomerate and lower sandstone (informal) that generally occupy the same stratigraphic position, lying between the Paveloff and Snug Harbor siltstones (fig. 2-3). The commonly boulder-bearing Chisik of this study only occurs in the Iniskin Bay–Mount Pomeroy area (fig.2-1) and stratigraphically transitions into the lower sandstone member approximately 2 km west of Oil Bay (fig. 2-3). The lower sandstone at Oil Bay is nearly devoid of gravel-sized clasts, and we observed no mappable intertonguing of these units in the Tilted Hills. Both the Chisik and lower sandstone typically exhibit notably more resistant weathering profiles than the underlying Paveloff (fig. 2-5). However, in some exposures, the Paveloff–lower sandstone contact can be somewhat enigmatic where the basal lower sandstone strata do not exhibit a striped color scheme of alternating medium-brown- and light-gray-weathering beds that is common to the unit (fig. 2-4). In such areas, a contact must be correlated to nearby accessible outcrops where

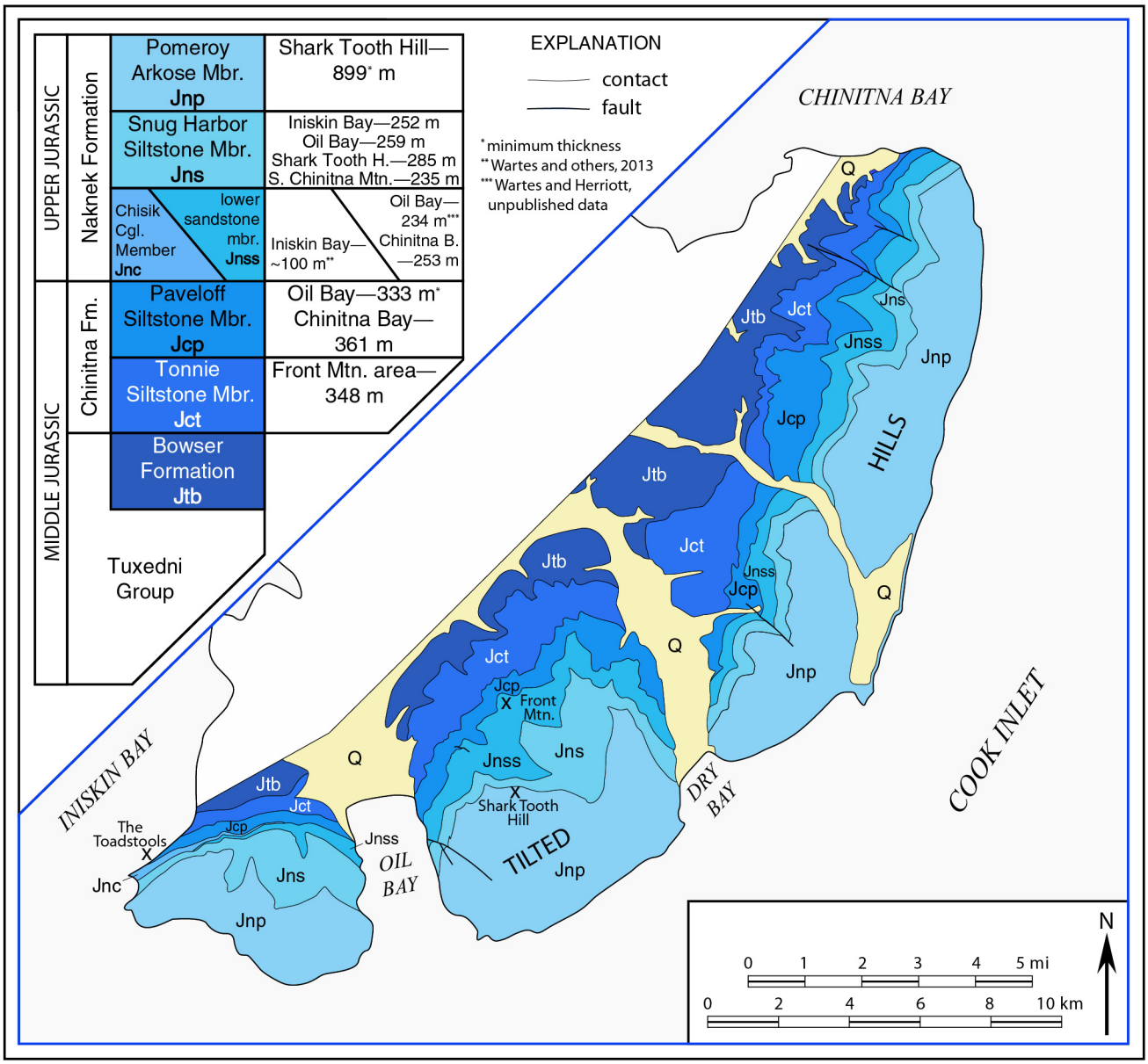

Figure 2-3. Simplified geologic map of the Tilted Hills. This preliminary sketch map is based on 1:63,360-scale mapping completed during the 2013 field season and is part of a larger project focused on mapping the entire Iniskin Peninsula (chapter 1, this volume). Stratigraphic column modified after Detterman and Hartsock (1966). Stratigraphic thicknesses reported are from the current study unless otherwise noted. See figure 2-1 for location index map.

detailed observations of lithofacies, fresh color, and composition can be made: the Paveloff is typically more silt-rich, thinner bedded, greener colored, and less arkosic.

The Chisik and lower sandstone are overlain by the Snug Harbor Siltstone Member (Naknek Formation), with the notable exception of the Mount Pomeroy area where the lower sandstone overlies Chisik (fig. 2-3). The base of the Snug Harbor is commonly readily mappable along an abruptly recessive surface (fig. 2-5). This dark-weathering, fine-grained unit locally contains sandstone beds, and conglomeratic sandstone and conglomerate are minor but notable constituents of the Snug Harbor. Despite being recessive at its base, the Snug Harbor locally crops out within resistant peaks of the Tilted Hills (fig. 2-4).

The Pomeroy Arkose Member (Naknek Formation) forms extensive cuestas and flat-irons (fig. 2-2) and is generally the most conspicuously mappable unit in the Tilted Hills, with the Snug Harbor–Pomeroy contact being mapped along the base of cliff-forming amalgamated arkose (fig. 2-5). The chiefly gray-weathering Pomeroy is dominantly sandstone, although thick packages of siltstone as well as conglomerate are observed. The top of the unit is not exposed in the map area.

Figure 2-4. Mappable characteristics of Chinitna and Naknek Formation members, with view southeastward of an unnamed mountain northeast of Front Mountain (figs. 2-1 and 2-3). The medium-brown-weathering color of Tonnie (Jct) contrasts well against the dark-gray-brown-weathering color of the overlying Paveloff (Jcp). The Tonnie–Paveloff weathering color transition is also commonly coincident with a similarly mappable break–in-slope (red arrow). Note that onset of the striped color character of part of the lower sandstone member (Jnss) here lies several tens of meters above the unit's base. The Snug Harbor Siltstone Member (Jns) weathers recessively in part, but comprises the mountain's summit here (orange arrow). Jcp is typically >300 m thick in the study area for sense of scale

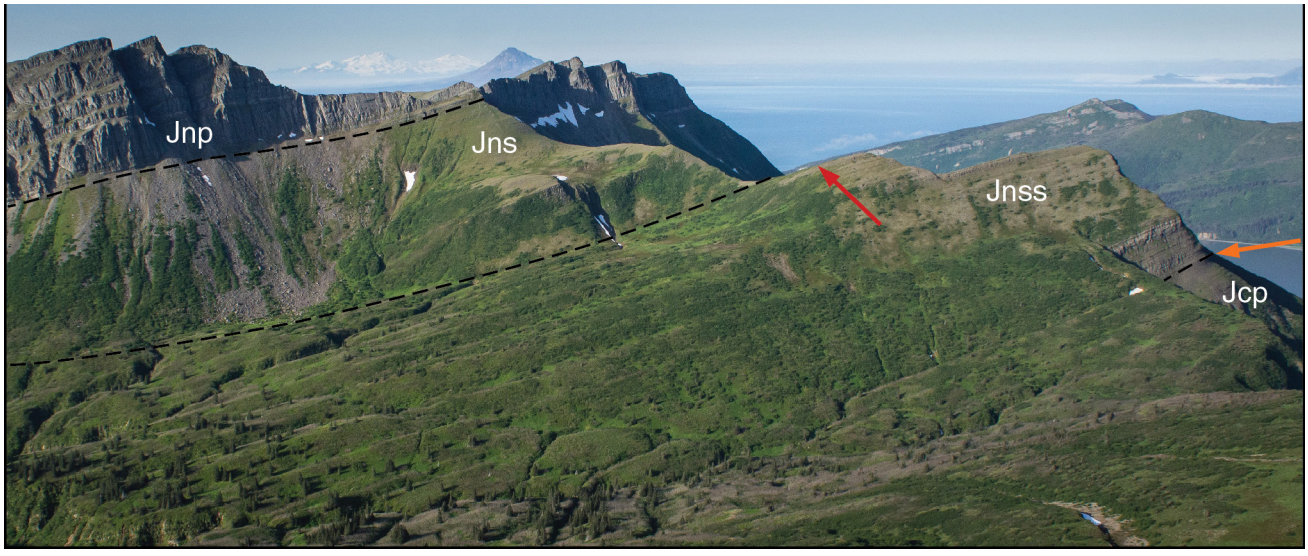

Figure 2-5. View southwestward of Cy Peak (immediately right of red arrow; fig. 2-1) and Shark Tooth Hill (photo-left skyline; figs. 2-1 and 2-3) area, exhibiting typical weathering profiles of Paveloff (Jcp) through Pomeroy Arkose (Jnp) members. The base of the lower sandstone (Jnss) lies at the break-in-slope marked by the orange arrow. A characteristic dip slope at the top of the lower sandstone marks the abrupt contact with the Snug Harbor Siltstone Member (Jns; red arrow). Cliffs consisting of Pomeroy strata are at photo-center and photo-left skyline. Jns is approximately 285 m thick for sense of scale.

The geologic mapping criteria briefly outlined here, and more thoroughly summarized by Herriott and Wartes (in press [2014]), will serve in part as a basis for pending interpretive reports regarding sedimentation in the Cook Inlet forearc basin during latest Middle to Late Jurassic time. This work will contribute to a better understanding of basin evolution and the hydrocarbon potential of Mesozoic strata in the Cook Inlet region.

ACKNOWLEDGMENTS

We thank Rebekah Tsigonis for field assistance and camp support; Rick Stanley (U.S. Geological Survey) and Ken Helmold (Alaska Division of Oil & Gas) for constructive conversations in the field; Mike Fell (Pathfinder Aviation) for helicopter support; Merril and Marti (Bear Mountain Lodge) for their hospitality; Jack Barber (Alaska Air Taxi); Bald Mountain Air; and David LePain and Andrea Loveland for careful review of this report. The Iniskin Peninsula area mapping project was funded by a substantial contribution from the U.S. Geological Survey STATEMAP Program (award no. G13AC00157).

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