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DINKUM SANDS

BY

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The State/Federal Beaufort Sea lease sale in December 1979 attracted over one billion dollars in bids. Tracts with the highest bids, and apparently with the highest oil potential, lie in the area south of Dinkum Sands, and within a three-mile radius of the shoal (Fig. 1). Jurisdiction over the tracts within the three-mile radius depends on whether Dinkum Sands is an island, as shown by published charts and claimed by the State, or a mainly submerged shoal or bar as claimed by the U.S.G.S. If Dinkum Sands were an island, even the tracts halfway between the mainland and the island chain might be disputed as they then would be considered to form an enclave totally surrounded by State lands. Thus Dinkum Sands holds a strategic position within the lease sale area and, for the production life of the oil field, will be monitored at 5-minute intervals to provide a basis for division of the income from future oil production in that lease sale area.

Our first visit to Dinkum Sands on July 15, 1979 was prompted by reports that the State of Alaska had 'rediscovered the island.' The shoal, as seen from a helicopter on that date and photographed (Fig. 2) is studded by a series of isolated, small, irregular gravel mounds which break the sea surface. Many small grounded ice floes, remnants of ice piling on the shoal in the previous fall, form most of the light-colored, irregular surface features in the photograph. Submerged sea-ice kettles and ice gouges separate the line of gravel mounds.

Our next visit to the shoal was with the R/V Karluk on July 25. We made a bathymetric survey around the shoal and searched for the highest point of Dinkum Sands. We used precise range -range navigation and a survey fathometer together with visual observation of the sea surface for signs of shallow

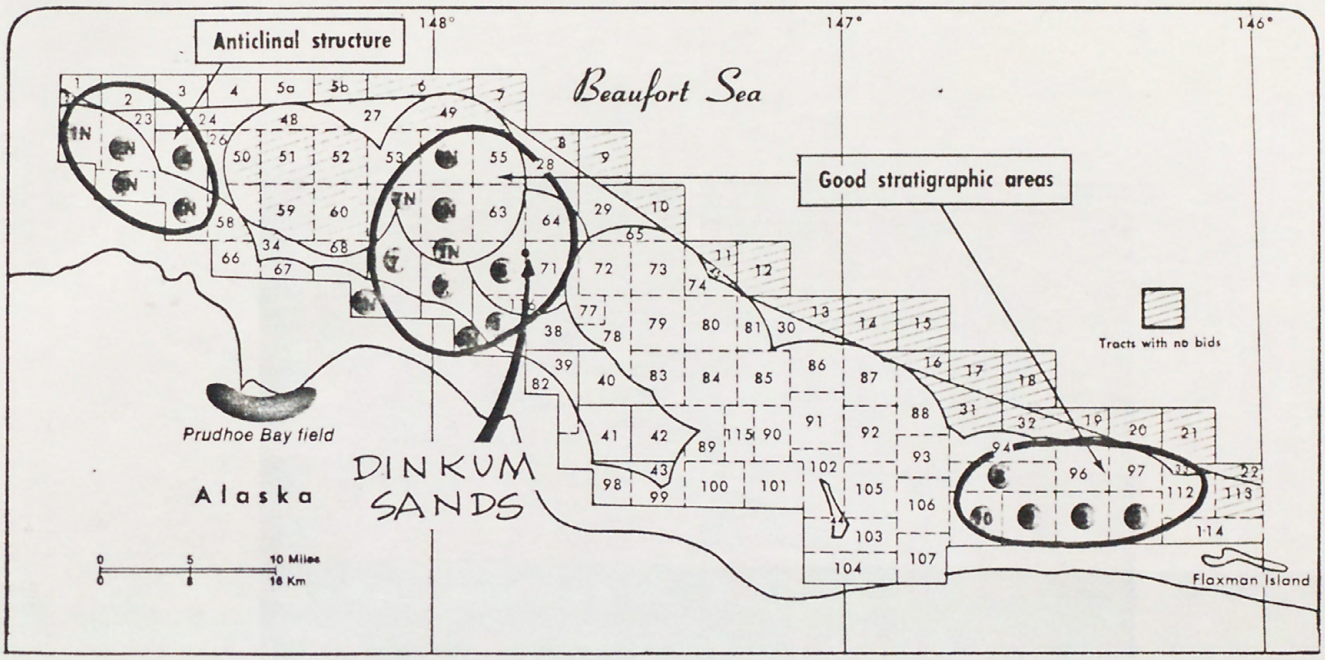

Figure 1. Location of Dinkum Sands and the lease sale tracts in the Beaufort Sea. The tracts adjacent to Dinkum Sands received the highest bids. (Modified after Oil and Gas Journal, Dec. 17, 1979, p.26).

Figure 2. Aerial photograph of Dinkum Sands on July 15. 1979. The major gravel mounds above sea level are shown by white arrows. All other white objects are grounded ice.

water. During this time the shoal was entirely submerged. The survey ended at the shoalest spot where the vessel ran aground and one of us waded across the crest of Dinkum Sands, finding a minimum water depth of 30-40 cm.

The tracklines we surveyed on July 25 are shown in figure 3. The fathograms, with times keyed to the tracklines, are shown in figure 4. The water depths recorded are contoured at 1-m intervals, using the sea surface during the time of our survey (approx. 1200 to 1400 hrs) as a zero base (Fig. 5). Therefore this contour map does not account for tidal variation. According to tidal data recorded by the National Ocean Survey near Prudhoe Bay (Fig. 1) and received after completion of the contour map, the mean water level during the time of the survey was about 35 cm above mean lower low water at the tide station. The average tidal range in the area is about 15 cm.

The incoherent, gentle relief forms so characteristic of shallow water areas of the Arctic are prevalent around Dinkum Sands, as shown on the fathograms in figure 4. On the bathymetric contour chart (Fig. 4) these relief forms can only be shown as isolated, semicircular mounds and depressions because trackline coverage is not dense enough to allow correlation from one crossing to another. Based on our surveying experience in other similar areas, we know, however, that additional trackline coverage would only reveal an increased number of semicircular mounds and depressions. This phenomenon is not observed in similar settings at low latitudes and we have no good explanation for it.

On August 23 State and Federal Officials accompanied us on the R/V Karluk for a visit to Dinkum Sands where the State had placed a flag over a survey monument on the highest point (Fig. 6). The survey monument had been placed flush with the surface of the shoal on this spot. At the time of our visit the monument was beginning to protrude due to erosion of surface gravel. The shoal was submerged under 20 cm of water.

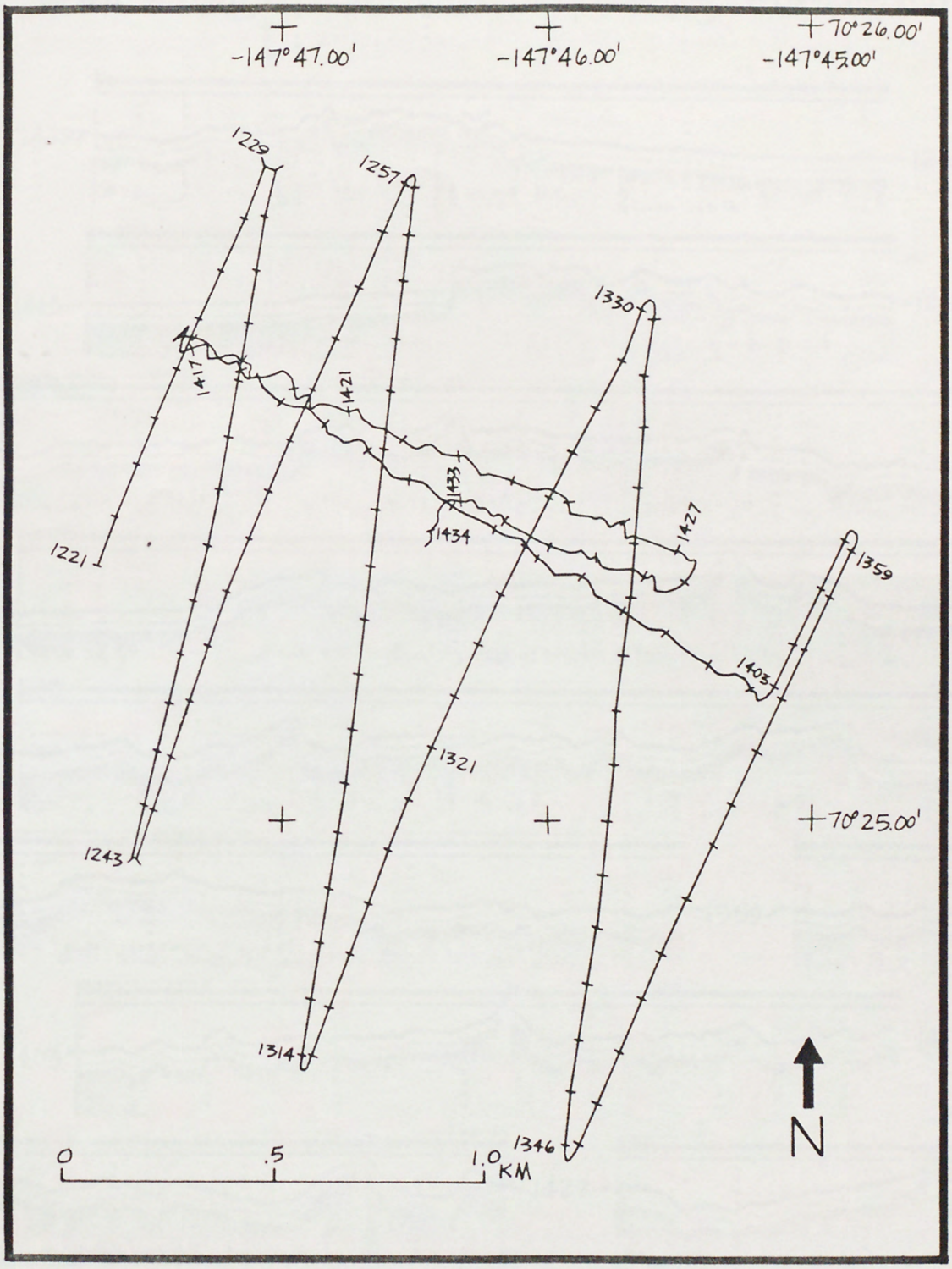

Figure 3. Tracklines surveyed on July 25, 1979 in a search for the shallowest point on Dinkum Sands. The survey ended where the vessel ran aground, 1434 local time.

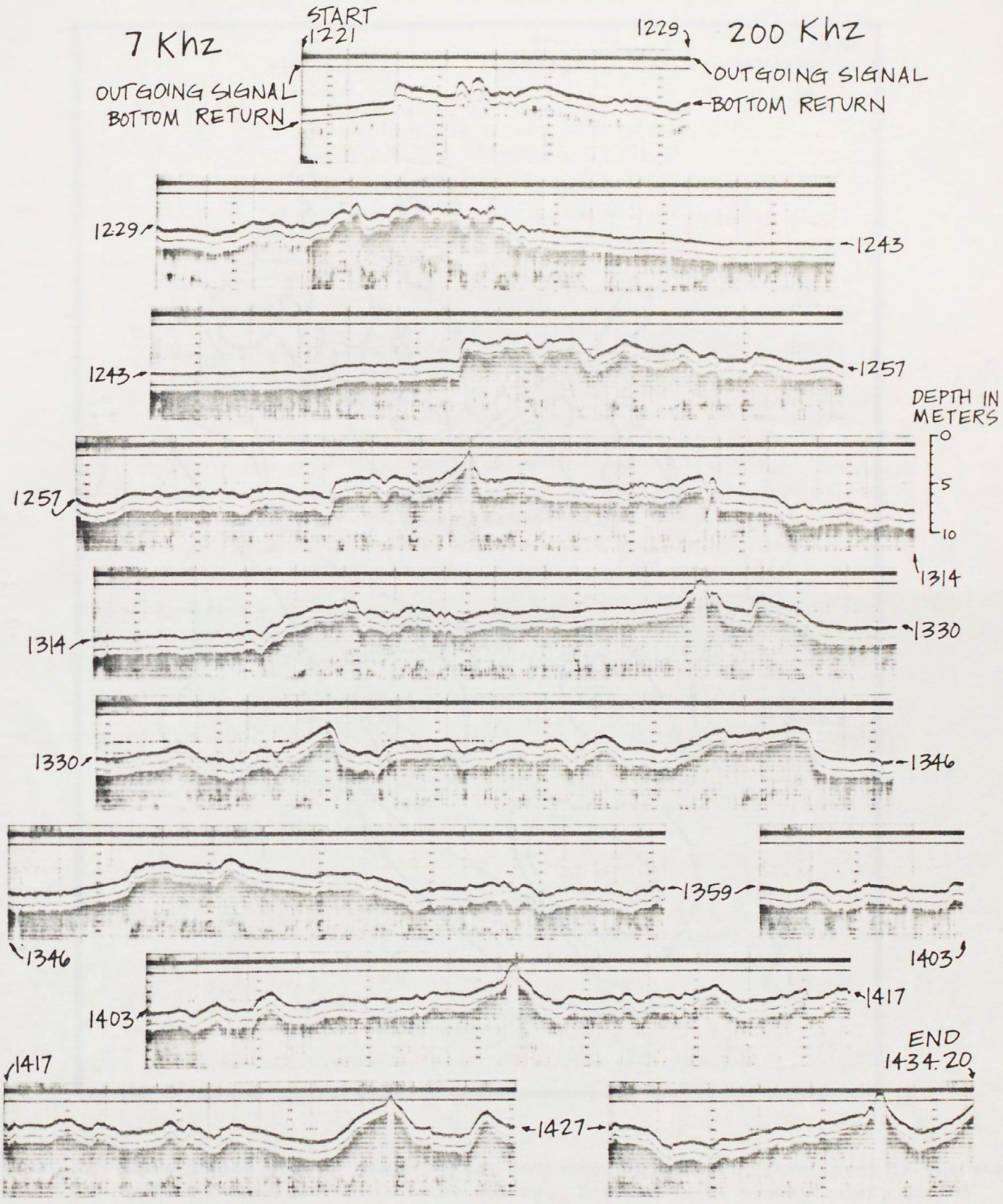

Figure 4. 200 kHz fathometer and 7 kHz sub-bottom profiles recorded along and keyed by time to tracklines of figure 3. (Prepared at Marine Science Data Center, Project Chief T.E. Chase, by Jeff Young).

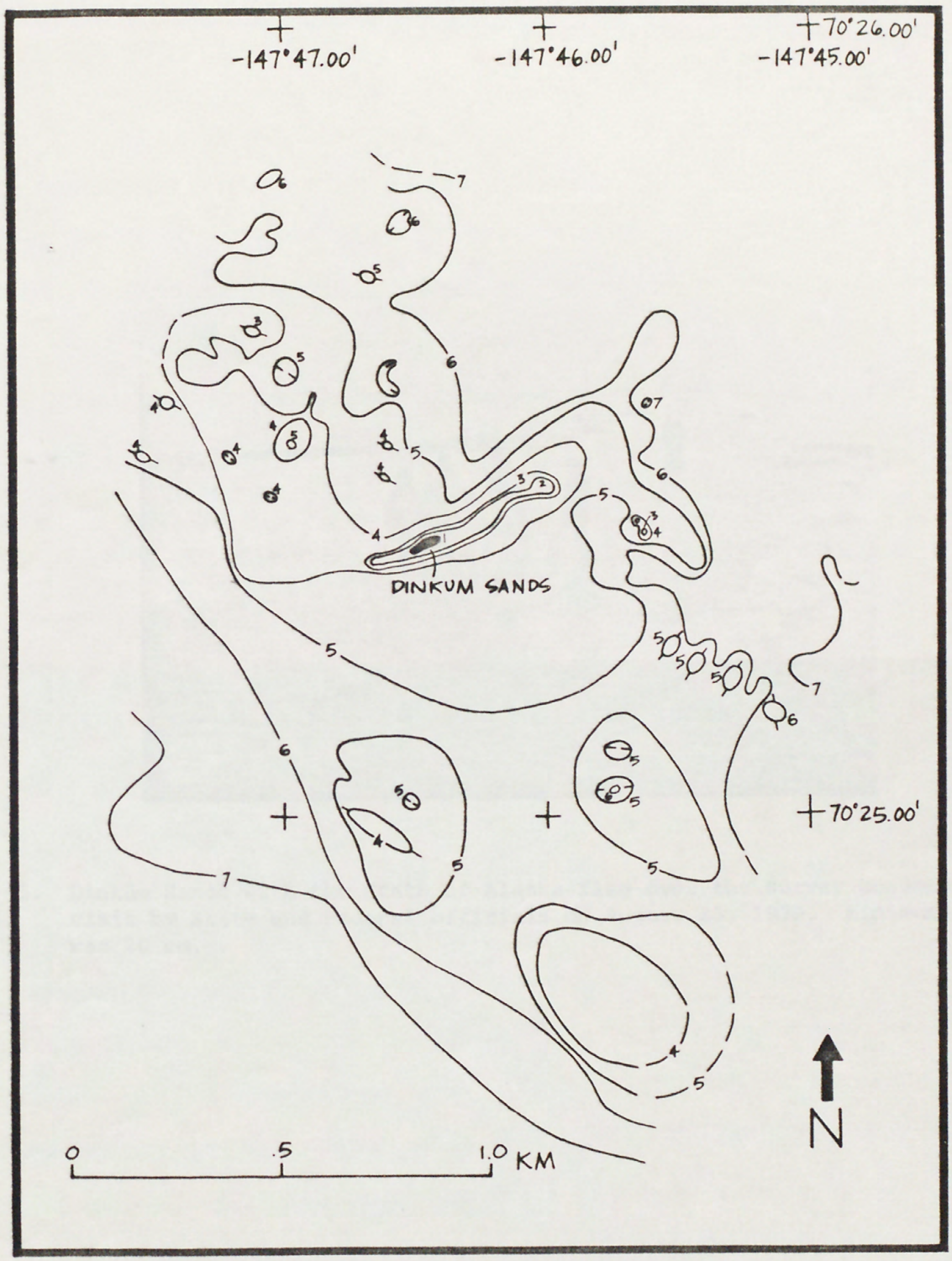

Figure 5. Water depths around Dinkum Sands, contoured in meters. Zero level is the sea surface during the time of the survey. Note numerous semicircular, closed depressions and elevations of 1 m, characteristic for Arctic shallow water areas.

Figure 6. Dinkum Sands with the State of Alaska flag over the survey monument, during a visit by State and Federal officials on August 23, 1979. Minimum water depth was 20 cm.

There were a number of flights over Dinkum Sands before and after this date, and the R/V KARLUK visited the shoal several times after our August 23 visit. The shoal was observed both above and below water during these visits. On September 8, when the sea level was very low, the crest of the shoal was 50 cm above sea level and measured approximately 30 m by 5 m at the water line. During the last visit of the season on September 23, the shoal crest was 10 cm above water and had shifted 15 m in a direction of 127^{0}T from the State monument. By this day erosion had excavated the top 72 cm of gravel from around the monument.

A total of twelve observations of Dinkum Sands were made during the summer of 1979 by members of our team and other reliable observers. These observations revealed that on four occasions the area was above water and on eight occasions the area was under water. On one occasion when the area was seen above water the sea level was known to be abnormally low. The crest of the shoal shifted southeastward by at least 15 m in one month and probably continued to shift until freezeup.

Hydraulic processes are probably responsible for the overall shape of the shoal, although ice shove also plays a part. The irregular mounds breaking the sea surface at breakup were clearly the result of ice plowing on the back of the submerged linear shoal. The mounds were in disequilibrium with wave and current-related processes and therefore were removed in less than ten calm-weather days with limited fetch for wave generation.

A comparison of the bathymetry around Dinkum Sands as surveyed in 1950 and 1979 (Fig. 7) shows that the high spots are at nearly identical locations. This is surprising, because the crest shifted approximately 15 m in a period of one month and the surrounding seabed has changed

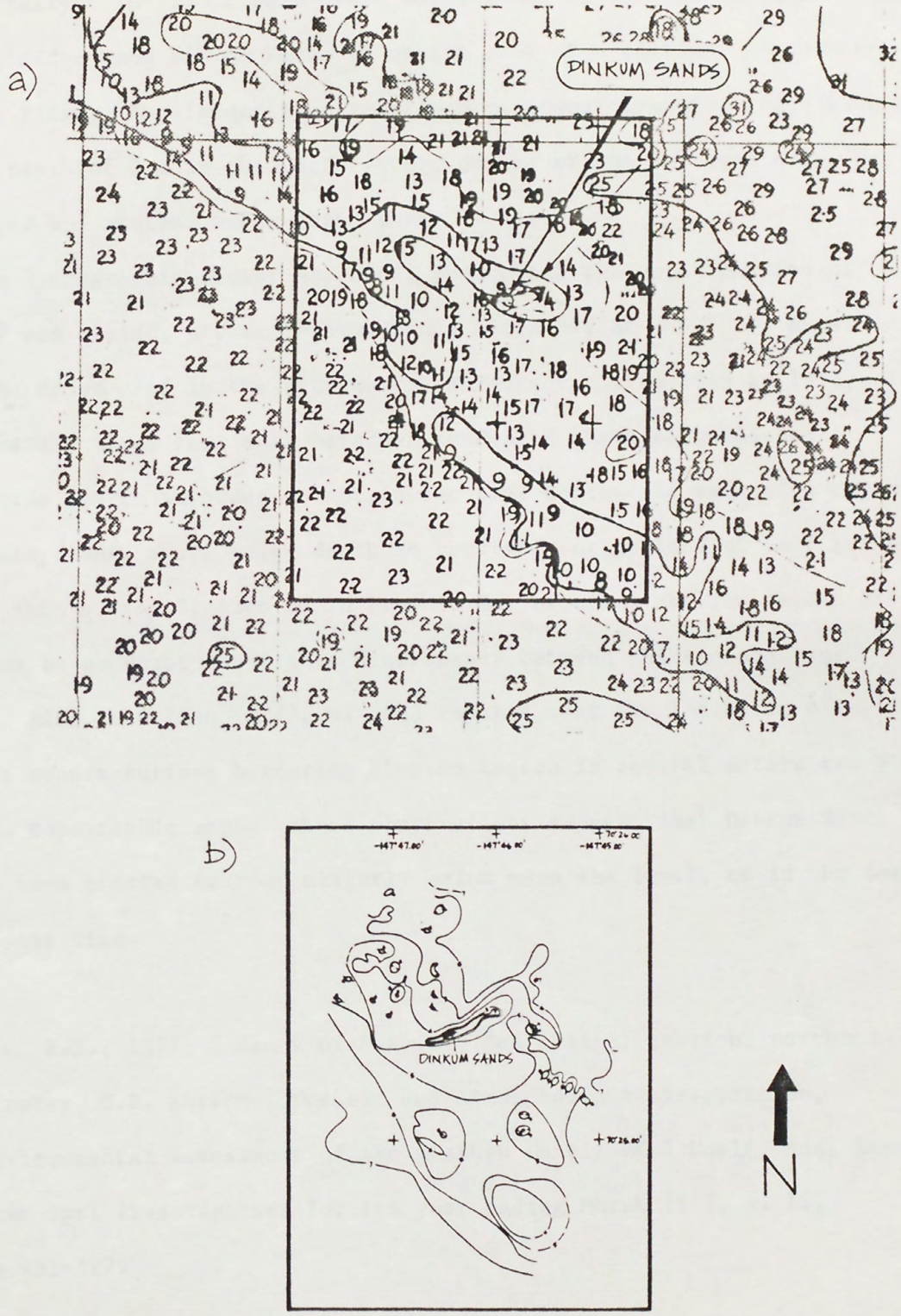

Figure 7. Comparison of bathymetry as surveyed in 1949/50 and 1979.
a) Copied from Hydrographic Survey No. 7761, with depth in feet.
b) Reduced from figure 5 to same scale as in a)--depth in meters.

substantially. In 1950 Dinkum Sands was located on the back of a northwest-trending ridge--now Dinkum Sands is on the back of a distinct northeast-trending ridge. The formerly well-defined northwest-trending ridge with a minimum depth of 3 m in the southeastern corner of the surveyed area, has been eliminated and minimum water depth there is 5 m.

The Hydrographic Survey No. 7761, from which the upper portion of figure 7 was copied, states "Dinkum Sands bares 3ft at MHW." We question the elevation datum used in the bathymetric surveys run from 1949 to 1951, because approximately three feet must be added to depths shown on published bathymetric charts in order to obtain the true depth. In extensive regions of smooth sea floor, where water depth is constant for periods of half an hour or more of ship's travel, such as in Prudhoe Bay or other shallow lagoon areas, there can be no doubt about this discrepancy between charted and true depths. Also, Lewellen (1977, p. 508) reports that the indicated elevation of the flat tundra surface bordering Simpson Lagoon is several meters too high on U.S.G.S. topographic maps. These observations suggest that Dinkum Sands may in fact have crested near or slightly below mean sea level, as is the case at the present time.

Lewellen, R.I., 1977, A study of Beaufort Sea coastal erosion, northern Alaska: U.S. National Oceanic and Atmospheric Administration, Environmental Assessment of the Alaskan Continental Shelf, Ann. Repts., Principal Investigators for the year ending March 1977, v. 15, p. 491-527.