INFLUENCE OF THE YUKON RIVER ON THE BERING SEA

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(Progress Report)

As specified by the contract this is the first semi-annual progress report concerning NAS 5-28769 entitled, "Influence of the Yukon River on the Bering Sea". The purpose of this project is to study relationships between discharge of the Yukon River to currents and biologic productivity in the northern Bering Sea.

Amended specific objectives are:

1. to develop thermal, sediment and chlorophyll surface maps using TM data of the discharge of the Yukon River and the Alaska Coastal Current during the ice free season;
2. to develop a historical model of the distribution of the Yukon River discharge and the Alaska Coastal Current using Landsat MSS and NOAA satellite imagery; and
3. to use high resolution TM data to define the surface dynamics of the front between the Alaska Coastal Current and the Bering Shelf/Anadyr Current.

Landsat MSS and TM, and AVHRR data were recorded during the 1985 ice-free period. The satellite data coincided with shipboard measurements acquired by ISHTAR project scientists (ISHTAR: Inner Shelf Transfer and Recycling is an NSF funded project in the area). Circumstances were such, that on July 5 all three sensors recorded data creating a unique data base for analysis. The July 5 MSS data was

density sliced to display the distribution of turbid water at the entrance to Norton Sound (Figure 1). The results are similar to patterns displayed by Burbank (1974). The July 5 TM data (thermal band) shows water-surface temperatures also at the entrance to Norton Sound along the boundary between the warm Alaska coastal water mass and cold Bering/Anadyr water mass (Figure 2). The July 5 AVHRR data (thermal band) was contrast stretched to show the distribution of water masses and upwellings for the northern Bering Sea region (Figure 3). The distribution of the water masses is similar to those derived from shipboard measurements (Coachman et al., 1975).

Most of our analysis efforts have concentrated on Objective 2. The interannual boundaries of turbid water have been mapped from historical MSS imagery recorded between 1974-1978. An integrated model of the distribution of turbid water discharged from the Yukon River has been compiled (Figure 4). The map shows that turbid water discharged from the Yukon River extends northwest of the Yukon Delta across the entrance to Norton Sound. The extent of turbid water coincides with surface and water column measurements of suspended sediment with values ranging from 2-8 mg/l (Sharma, 1979). The distribution of the turbid water also coincides with large weight distributions of silt and lower distribution of sand in bottom sediments near the delta (McManus et al., 1977; Sharma, 1979; and Burbank, 1974). The amount of silt in the bottom sediments decrease to the northwest (McManus et al., 1977).

A similar model is also being compiled of the Alaska Coastal and Bering Shelf/Anadyr water masses based on their thermal expressions seen on AVHRR imagery. This model also spans the 1974-1978 time frame. The two models have more narrowly defined the boundaries and extent of

turbid water, water masses and upwellings. This refinement greatly reduces the amount of TM data required for the project as discussed with Locke Stuart, NASA-GSFC.

The coastline and bathymetry of the northern Bering Sea are being digitized and sea-bottom contours generated in a small, experimental area. If successful, the sea bottom will be contoured for the northern Bering Sea. This data base will serve three purposes: (1) provide a common digital data base to which TM, MSS and AVHRR data and derivative maps can be registered; (2) minimize mis-registration caused by differences in map and image projections and distortions; and (3) provide a basis to relate geographic locations, bathymetry and sea-floor morphology to spectral reflectance (turbidity) and distribution of water masses. The program will also generate profiles of bathymetry, reflectance and surface temperatures between any specified points.

During 1985 the ISHTAR project made five cruises in the region over the period of 28 June to 5 October. Temperature, salinity and selected biological data are available from all these cruises. These data have been used to delineate the Alaska Coastal Water Mass from the Bering Shelf/Anadyr Water Mass (dashed line in Figure 3). The thermal infrared image of the region (Figure 3) shows the water mass location and indicates several small scale physical processes, such as local upwelling around parts of St. Lawrence Island, that will be more intensively investigated in the coming field season.

References

Burbank, D.C., 1974. Suspended sediment transport and deposition in Alaskan coastal waters. M.S. thesis, University of Alaska, Fairbanks, 222 pp.

Coachman, L.K., K. Aagaard and R.B. Tripp, 1975. Bering Strait: The regional physical oceanography. University of Washington Press, Seattle, 172 pp.

McManus, D. A., V. Kolla, and D. M. Hopkins, 1977. Distribution of bottom sediments on the continental shelf, northern Bering Sea. U.S. Geological Survey, PP. 759-c, 31 pp.

Sharma, G.D., 1979. The Alaskan Shelf: Hydrographic, sedimentary and geochemical environment. Springer-Verlag, New York, pp. 272-362.

FIGURE 1. Mosaic of Landsat MSS images recorded on July 5, 1985. The images were density sliced and color coded. The colors represent various levels in the reflectance of water caused by suspended sediments. In decreasing order of apparent turbidity, yellow = highly turbid; green, red, pink and blue = clear water.

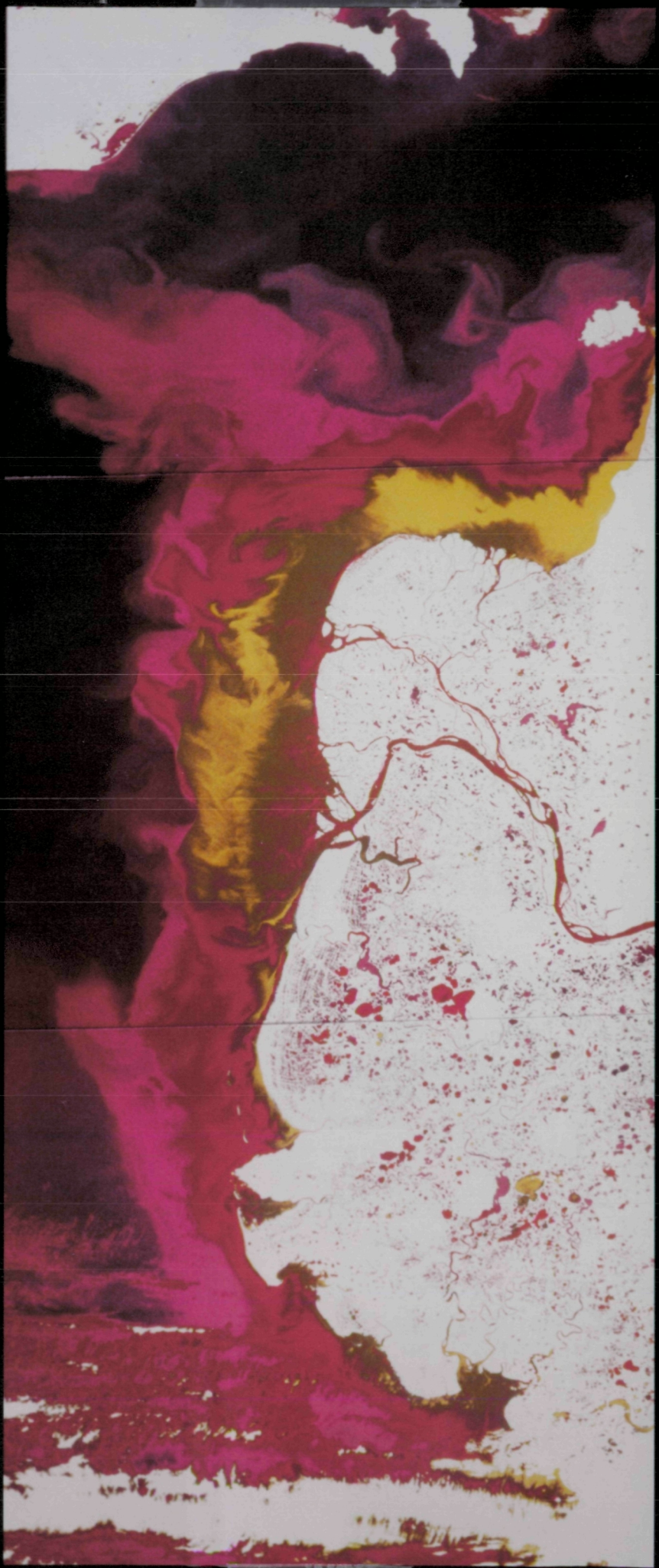

FIGURE 2. Landsat TM thermal image recorded on July 5, 1985. The shades of grey indicate water-surface temperatures with light shades representing warm water. Cool water on the left is Bering/Anadyr water and warm water on the right is the Alaska coastal water.

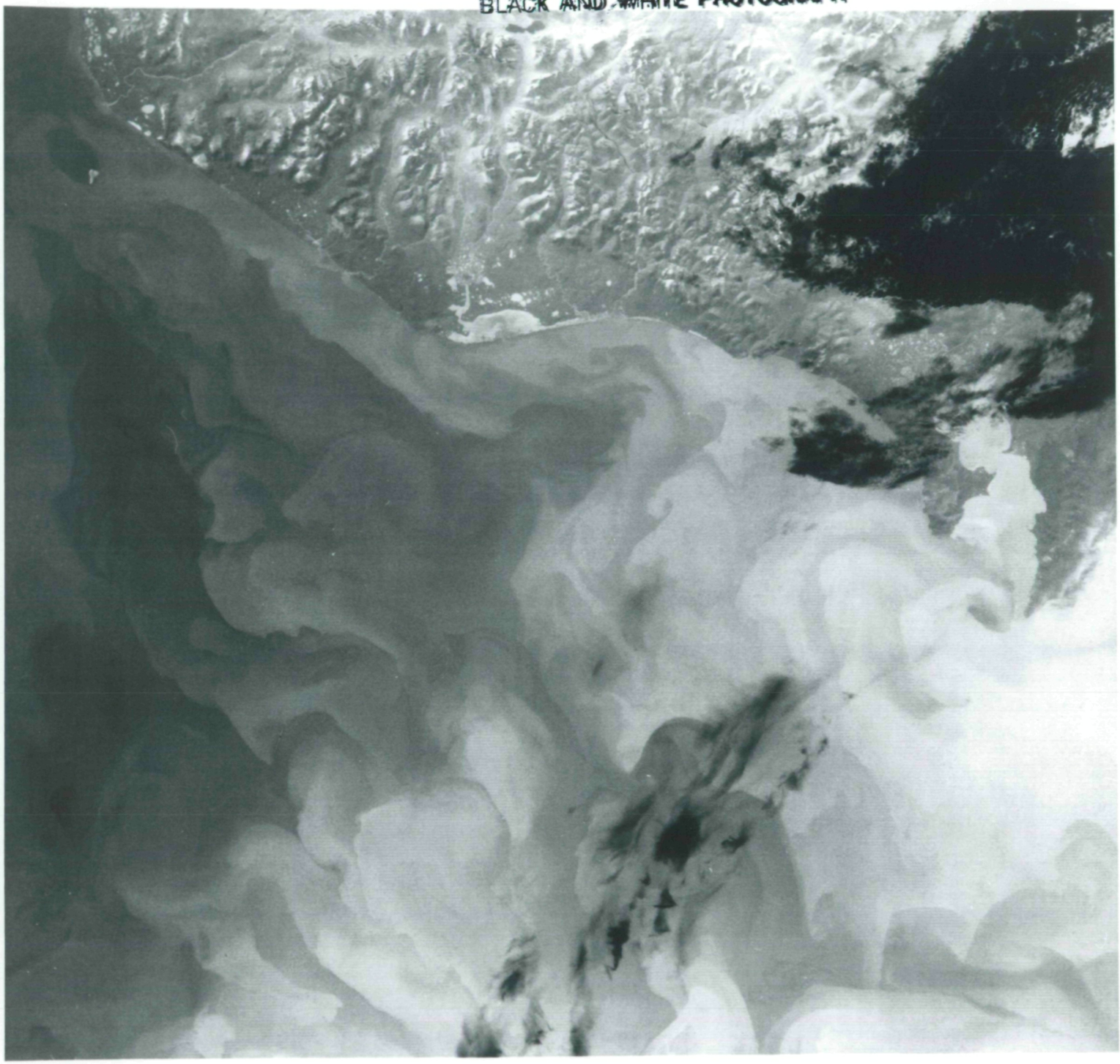

FIGURE 3. AVHRR thermal image recorded on July 5, 1985. Light shades are cool and black is warm land masses. Cold Bering/Anadyr water is center and left. Warm Alaska coastal water is right of center. "A" indicates the north-center of the TM image (Figure 2). The black line represents an integrated boundary between the Alaska coastal current and the Bering/Anadyr current derived from shipboard measurements in the water column.

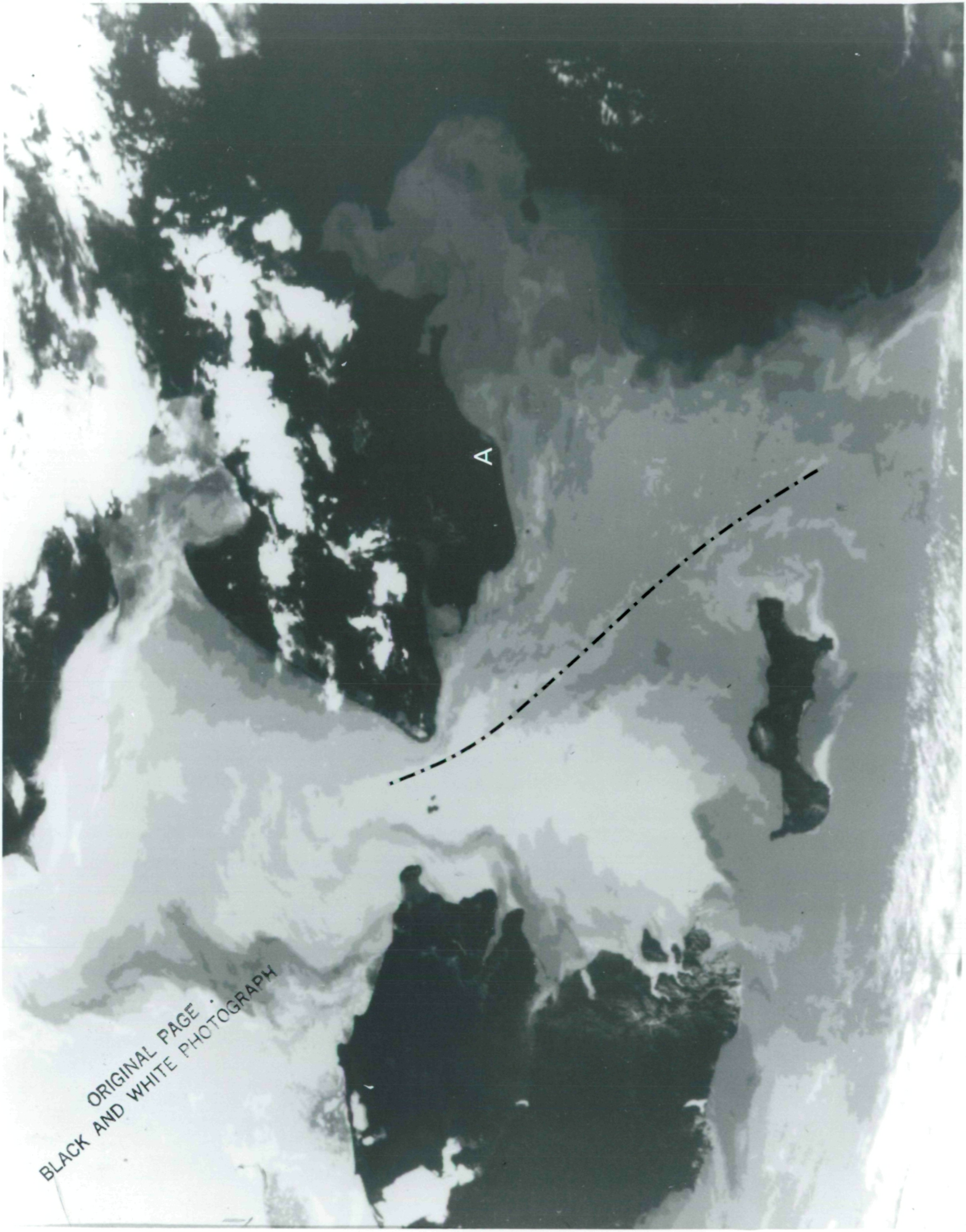

FIGURE 4. Integrated model of turbid water discharged by the Yukon River. The limits of turbid water were mapped from historical MSS imagery recorded between 1974-1978.

Model of the Distribution of Near-Surface Turbid Water Discharged from the Yukon River

Map Base - World Aeronautical Chart-Lambert Conformal Conic Projection

Data Base - Landsat MSS Imagery-Band 5 Recorded during ice-free periods 1974-1978

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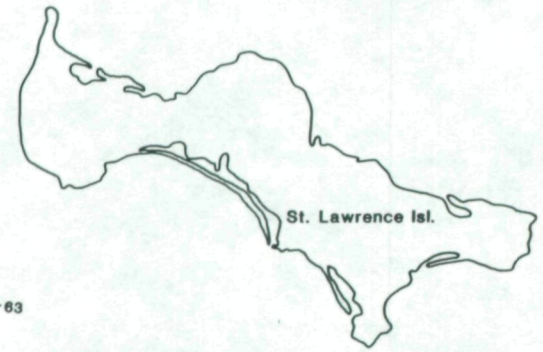
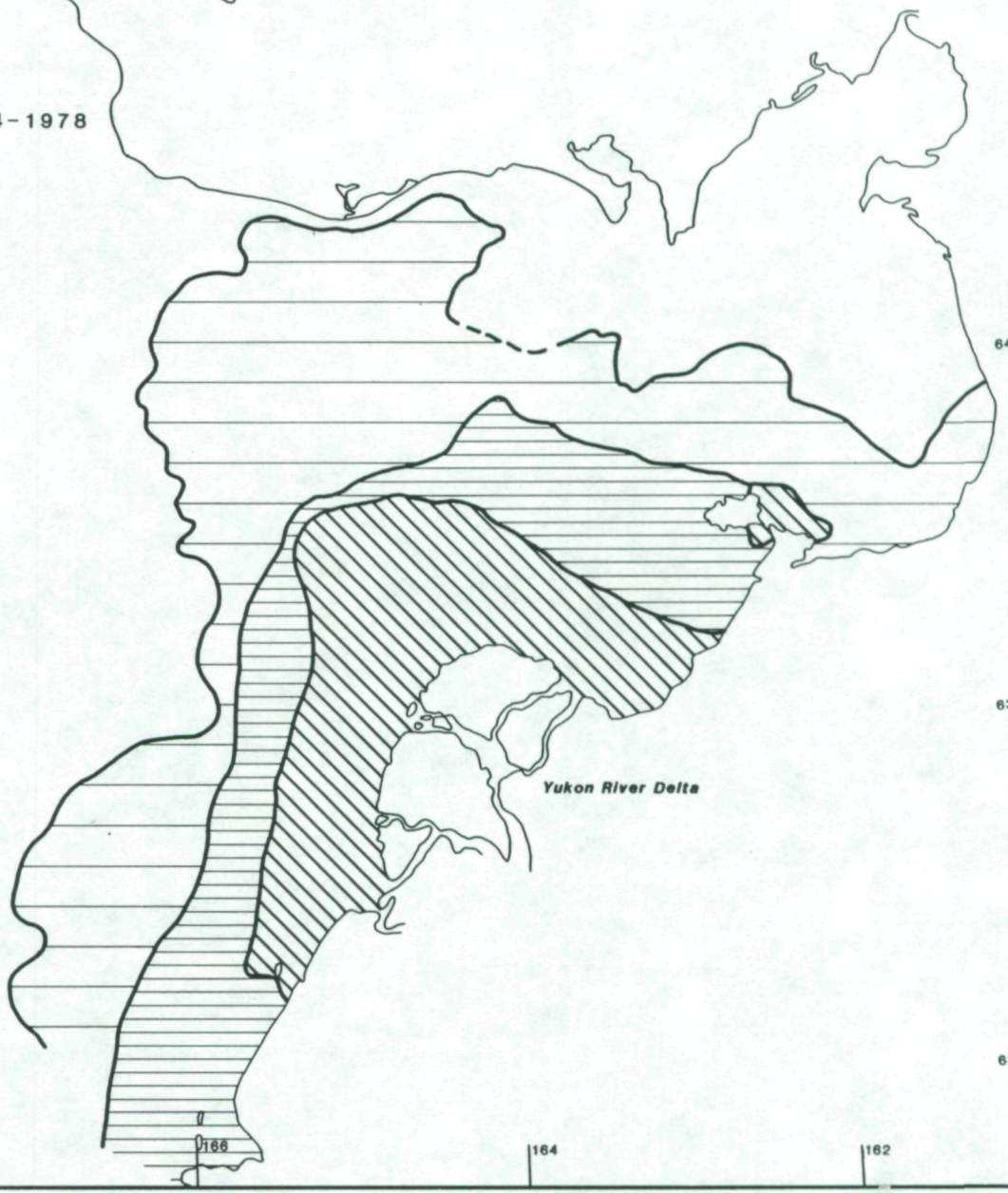
1985

Scale 1:1,000,000





LEGEND

- Zone that frequently has the greatest concentration of near-surface turbid water
- Zone that often has a moderate concentration of near-surface turbid water
- Zone that occasionally has a low concentration of near-surface turbid water

172 170 168 166 164 162

65 64 63 62