



Chukchi Sea Infaunal Population Structure and Sediment Biogeochemistry as Part of COMIDA and Shell Oil Exploration Environmental Studies

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INTRODUCTION

The Chukchi Sea continental shelf in the Pacific Arctic sector is influenced by the northward transport of nutrient-rich Pacific water that supports high water column and benthic production. Benthic studies were undertaken during a Shell Oil Exploration environmental studies program (2008, Fig. 1a) and the Chukchi Sea Offshore Monitoring in the Drilling Area (COMIDA): Chemical and Benthos (CAB) program (2009, Fig. 1b) to provide key baseline information on benthic infaunal community abundance and biomass as well as hydrographic e.g., (temperature, salinity) and sediment variables (e.g., grain size, organic carbon content) that influence infaunal community structure.

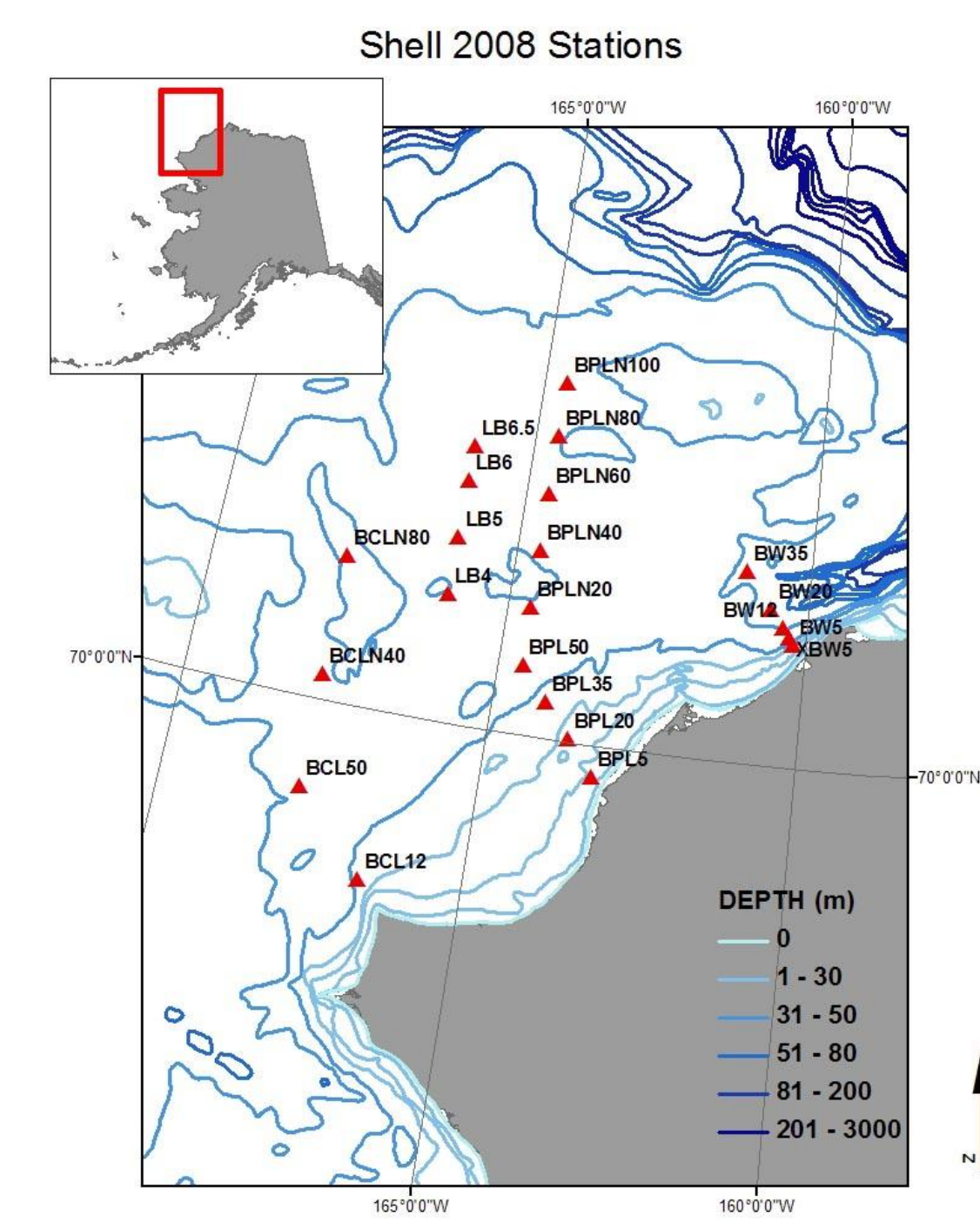


Fig. 1a-Shell 2008 cruise map.

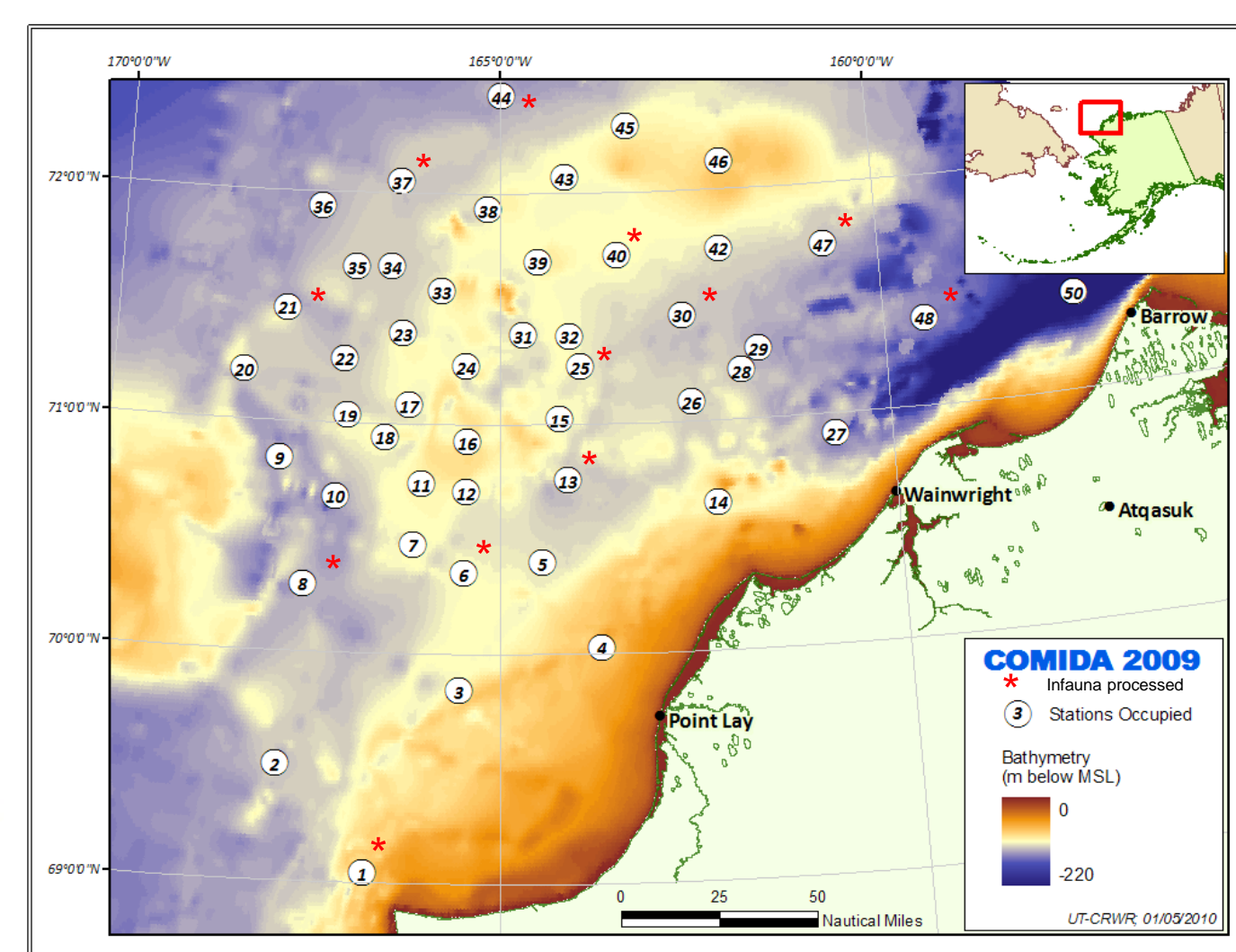


Fig. 1b-COMIDA 2009 cruise map.

METHODS

- Sediment samples were collected from a 0.1m² van Veen grab, frozen shipboard, and returned to the Chesapeake Biological Lab (CBL)
- Sediment samples were wet and dry sieved for grain size following Grebmeier et al. 2006
- Total organic carbon (TOC) was measured using a CHN analyzer at the CBL Analytical Facilities
- Infauna were collected with a 0.1m² van Veen grab and sieved through 1-mm screens and animals subsequently preserved in 10% buffered formalin
- Animals were identified, counted, and weighed at CBL



Collecting samples with a van Veen grab in the Chukchi Sea



Sieving infaunal samples in the Chukchi Sea

[photos by Ken Dunton]

RESULTS

Hydrographic conditions during July-August 2009 indicate that the southern regions of the COMIDA were under the influence of warmer, less saline Bering Sea and Alaska Coastal Water (ACW), and the northern region of the study area under the influence of colder, more saline Bering Shelf-Anadyr water (Fig. 2a,b), similar to reports in Feder et al. 1994. In addition, high salinity bottom water from remnant sea ice brine injection during ice formation is evident in offshore regions. Bottom water temperature was not measured in 2008.

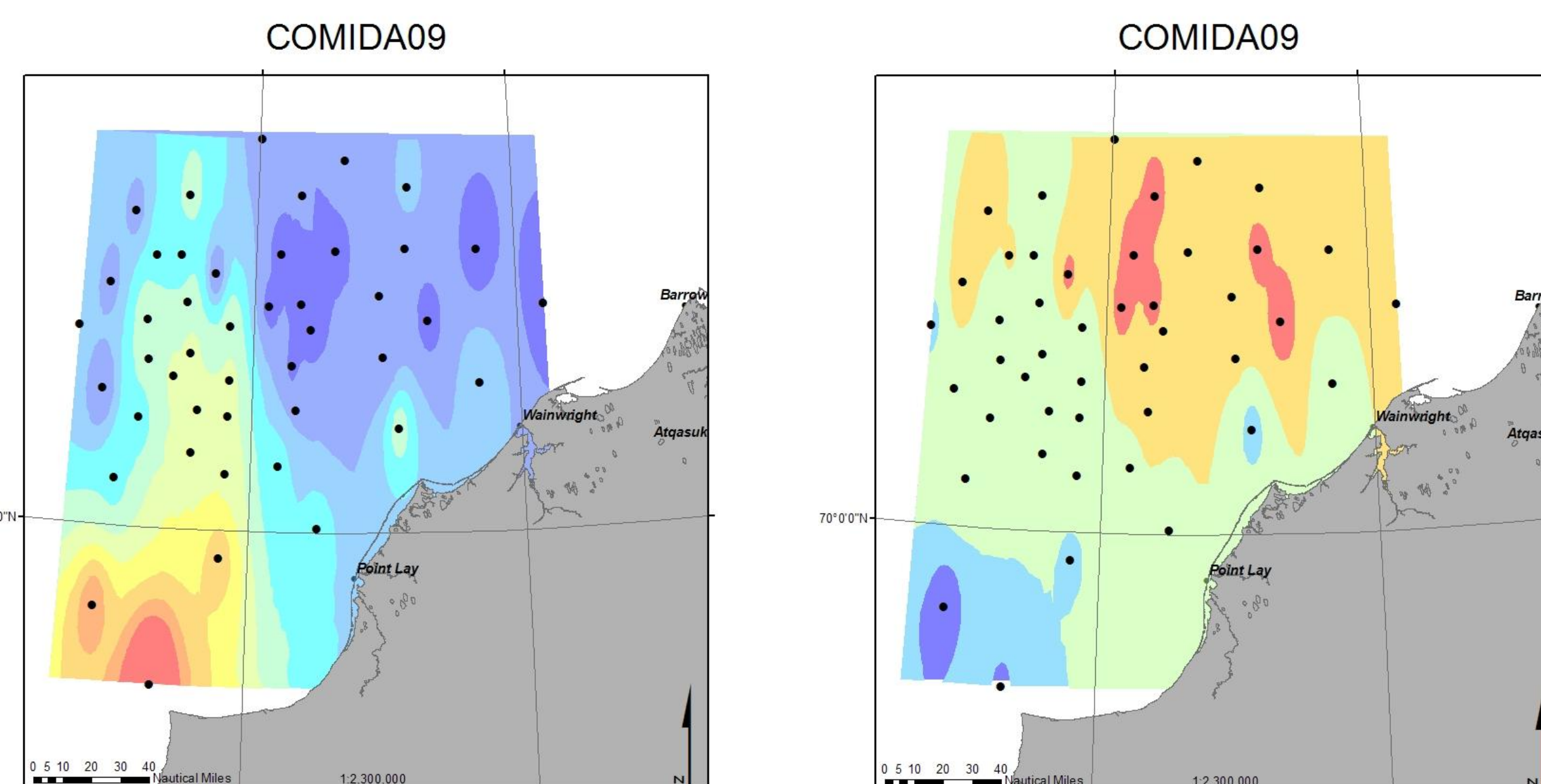


Fig. 2a-Bottom water temperature in the COMIDA area in 2009.

Fig. 2b-Bottom water salinity in the COMIDA area in 2009.

Surface sediment grain size varied from coarse sand and gravel in nearshore regions under ACW as well as shallow offshore bank regions (low silt/clay content-Fig. 3a). By comparison, highest silt and clay deposition zones occurred offshore, with a transition zone between the two regions. Total organic carbon was highest in offshore sediments (1.8%, Fig. 3b), with an average shelf value between 0.5-1%. C/N values in surface sediment (not shown) were between 6-8 in offshore waters, indicative of labile carbon, compared to more refractory organic materials (C/N>9) in nearshore surface sediments.

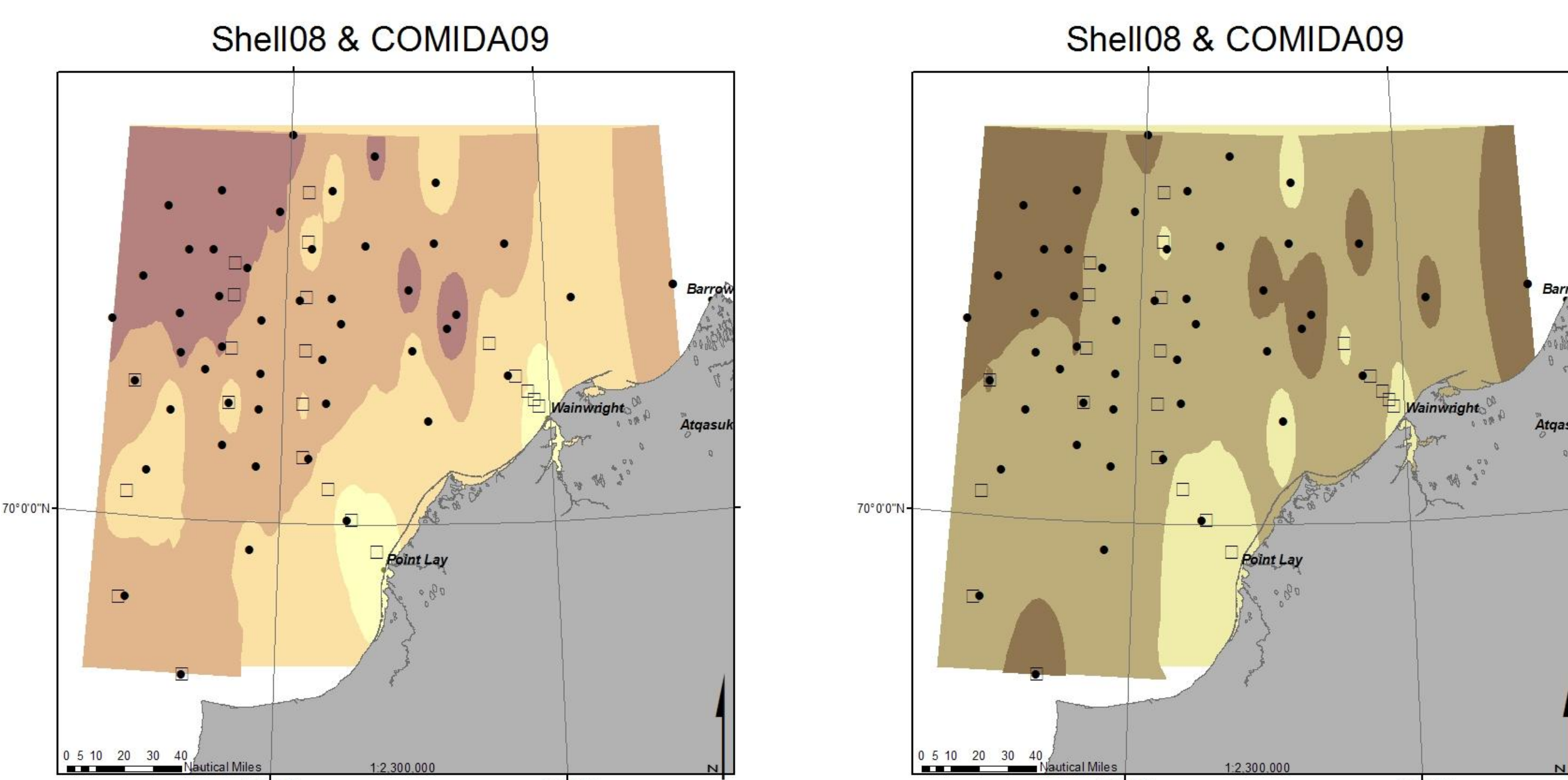


Fig. 3a.-Surface sediment grain size in the Chukchi Sea.

Fig. 3b.-Surface sediment TOC in the Chukchi Sea.

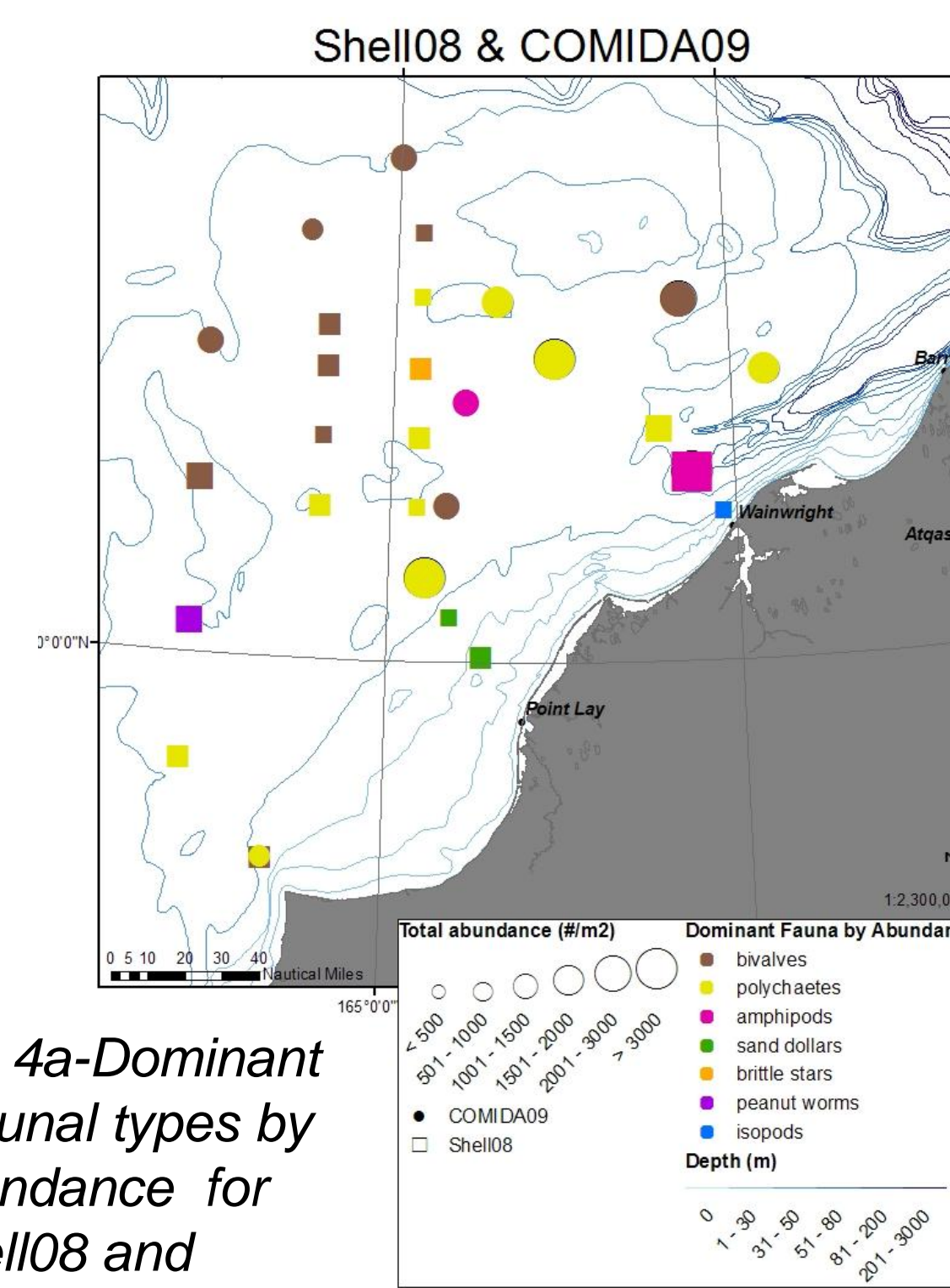


Fig. 4a-Dominant infaunal types by abundance for Shell08 and COMIDA09 studies.

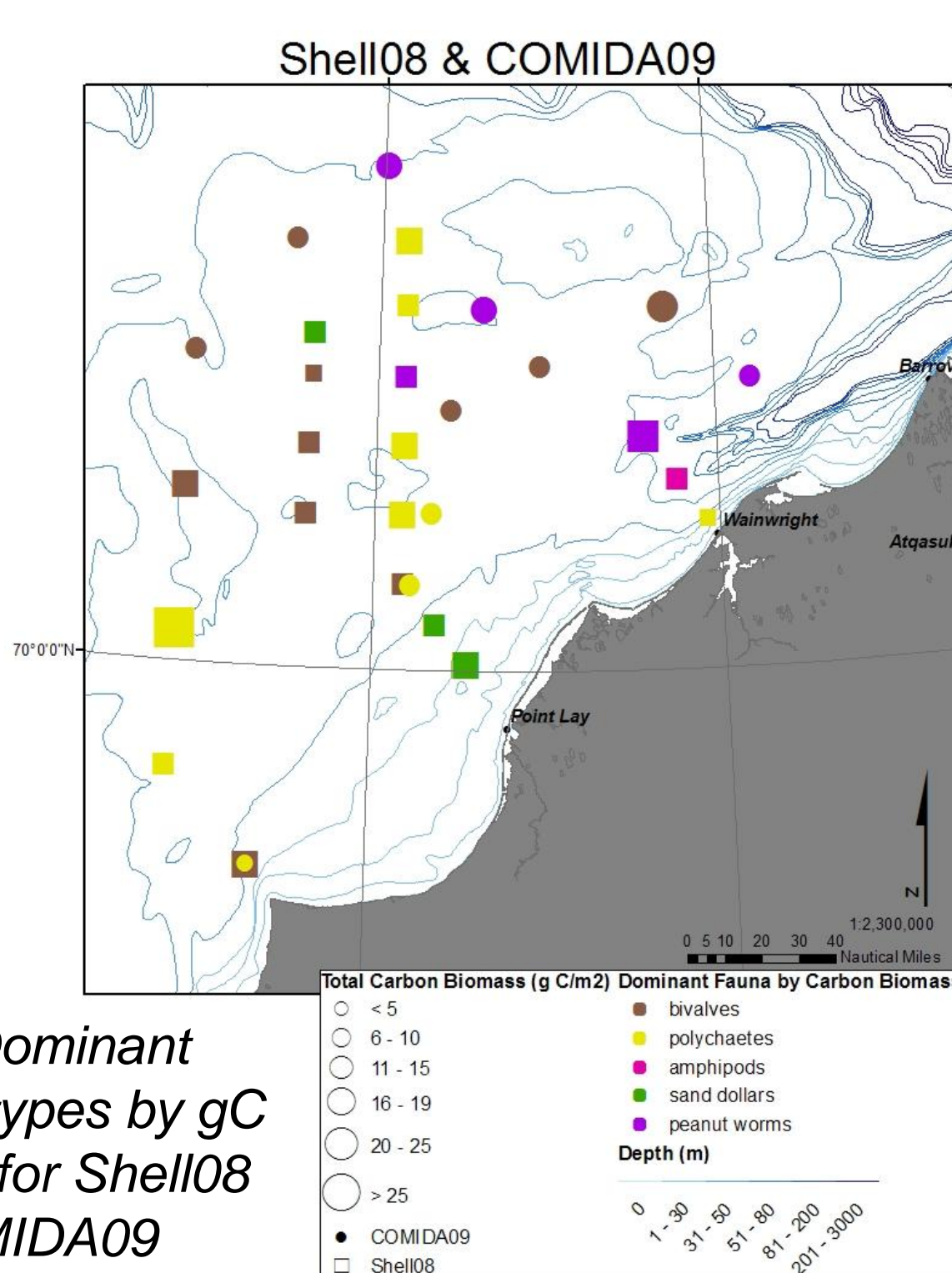


Fig. 4b-Dominant infaunal types by gC biomass for Shell08 and COMIDA09 studies.

The dominant nearshore infaunal types by abundance (Fig. 4a) and biomass (Fig. 4b) were polychaetes (Families Maldanidae and Opheliidae) and sand dollars (Family Echinarachiidae), with amphipods (Family Ampeliscidae) and isopods (Family Sphaeromatidae) dominating at limited stations. The offshore areas were dominated in abundance and biomass by polychaetes (Families Cirratulidae, Lumbrinereidae, and Maldanidae), bivalves (Families Astartidae, Cardiidae, Nuculanidae, Nuculidae, and Tellinidae), and peanut worms (Family Sipunculidae). The dominant infaunal types reflect sediment grain size, which is a major driver for benthic community composition (Grebmeier et al. 2006). Deposit-feeding families of bivalves, polychaetes, and peanut worms dominated regions with fine, high silt and clay content. By comparison, suspension-feeding sand dollars, polychaetes, and amphipods were generally more important in the coarse sediments of nearshore waters. Higher benthic infaunal biomass areas (Fig. 4b), indicative of increased carbon supply, generally occurred offshore, with the exception of sand dollars in the nearshore region off Point Lay.

CONCLUSIONS

- Bottom waters in the northern Chukchi Sea have higher salinities and lower temperatures, with greater influence by seasonal sea ice processes, compared to the southern warmer and fresher water originating on the Bering Shelf
- TOC and sediment grain size indicate a gradient from coarser grain size, lower TOC sediments nearshore to higher percent silt/clay and TOC content in offshore sediments
- Benthic communities varied between nearshore and offshore infaunal populations, with suspension-feeding polychaetes, amphipods, and sand dollars dominating inshore waters with coarser sediments compared to deposit-feeding polychaetes, bivalves and peanut worms dominating the offshore waters with finer sediments

References

Feder HM, Naidu AS, Jewett SC, Hameedi JM, Johnson WR, Whitledge TE (1994) The northeastern Chukchi Sea: benthos-environmental interactions. Mar Ecol Prog Ser 111:171-190
 Grebmeier JM, Cooper LW, Feder HM, Sirenko BI (2006) Ecosystem dynamics of the Pacific-influenced northern Bering and Chukchi Seas in the Amerasian Arctic. Prog. Oceanogr. 71:331-361