

CHAPTER THIRTEEN

Analysis of Lipid Residues in Archaeological Artifacts: Marine Mammal Oil and Cooking Practices in the Arctic

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Pottery sherds, stone lamps and artifacts from archaeological sites in Alaska and Canada were selected from the archives of the National Museum of Natural History in Washington DC. Ancient organic residues were collected on the sherds, often incrustated as a thick layer. Lipids were extracted from these residues followed by derivatization and analysis by high temperature gas chromatography (HTGC) and combined gas chromatography mass spectrometry (GC/MS). Modern samples of whales and seals were also analyzed. Some of these fresh specimens were thermally degraded to simulate cooking and aging. Alkaline treatment was sometimes necessary to hydrolyze the insoluble lipid fraction.

Thousands of years ago, Eskimos settled on the American coasts around the Arctic Circle and developed a fascinating culture in one of the most extreme climates of the world.¹ The ancient inhabitants of the arctic and sub-arctic coastal areas adapted to an economy relying primarily on the sea. In regions where land mammals are rare and plant resources sparse, marine mammals (seals, whales and walrus) provide an essential source of raw materials: skins and furs for clothing, boots, kayaks and tents; bones and ivory for tools, weapons and decorative objects; meat and fat for food and fuel. The muscles and blubber of large sea mammals were important sources

for lipids and proteins and one individual could feed a family for days.

Blubber is a thick layer of fat and connective tissue located between the skin and the muscle of marine mammals. Blubber functions as insulation and as an energy store. It has a complex structure of fat cells and structural fibers made of collagen and elastin embedded in the fat matrix to give it both rigidity and elasticity. It is a good source of lipids but also provides proteins. Lipids composing the blubber are subject to variation and depend directly on the source of food. Studies show seasonal and geographical variations as well as compositional differences by sex, age and stage of pregnancy and lactation (Dahl et al. 2000; Grahl-Nielsen et al. 2003; Hamilton et al. 2004; Lockyer et al. 1984; Olson and Grahl-Nielsen 2003; Pabst et al. 1995). The oil rendered from the blubber was also used for fueling lamps (Blumer 1997; Lucier and Vanstone 1991; Nelson 1899; Spencer 1959).

Cooking Practices in the Arctic Coastal Areas

The inhabitants of arctic and sub-arctic coastal areas relied heavily on sea mammals (walrus, seals and whales) for their subsistence (Dumond 1998). Carbohydrates were absent in the diet and had to be compensated for by increased consumption of lipids and proteins. For example, for a family of 10 people with 8 dogs at Point Barrow, 60 kg of meat were necessary every day (Spencer 1959). Fish, birds and other small games were a complementary source of food, as well as roots, berries and seaweeds. Caribou was hunted when available, but this could only be found inland and the migration patterns of caribou are more unpredictable than those of the sea mammals.

In Alaska, wooden dishes were used to store water, oil or fermented food (mixtures of meat, fat and berries); fish and meat could then be eaten raw, dipped in oil. Food

¹ The general term Eskimo refers to all groups inhabiting the Arctic and Sub-arctic regions from North Eastern Siberia to Greenland. With the Aleuts, occupying the Aleutian Islands, they form the Eskimo-Aleut family from which are derived the different language groups: Aleut in the Aleutian Islands, Yupik in Eastern Siberia and Southwestern Alaska, and Inupiaq-Inuktitut, a continuum of dialects spoken from the coasts of Northern Alaska and Canada to Labrador and Greenland. Inuit is the term in use for Arctic populations in Canada and Greenland.

Theory and Practice of Archaeological Residue Analysis

was cooked by boiling or simmering, usually with oil rendered from blubber, in clay vessels to make stews and soups. Meat and fish were also roasted on an open fire when wood was available, or eaten frozen, dried or aged. 'Muktuk', a mix of skin and blubber that was consumed raw or cooked and that apparently tasted like coconut, was eaten with relish (Geist and Rainey 1936; Nelson 1899; Spencer 1959). Cooking by means of hot stones was practiced at Barrow (Reid 1990) and in southern Alaska (De Laguna 1956).

Open oil-burning lamps were an important utensil in daily life. Oil rendered from blubber provided fuel for the lamp. Made of clay or soapstone, the flat-bottom lamps were used for lighting, heating and cooking. On St. Lawrence Island a second pot fashioned of clay was hung above the lamp and used as a cooking pot. Another clay or wooden pot, in the shape of the lamp, could be placed under the wick to collect any dripping of oil (Collins 1937; Nelson 1899).

Oil-burning lamps were reproduced in the laboratory. Blubber was cut in 2 x 2 cm squares, placed in a modern clay saucer and lit with a straw wick. The blubber rendered oil and provided a constant flame for up to two hours (using about 10 ml of oil). A small cup was placed 5 cm above the lamp with 20 ml of water. The heat from the lamp was sufficient for the water to simmer but not to boil.

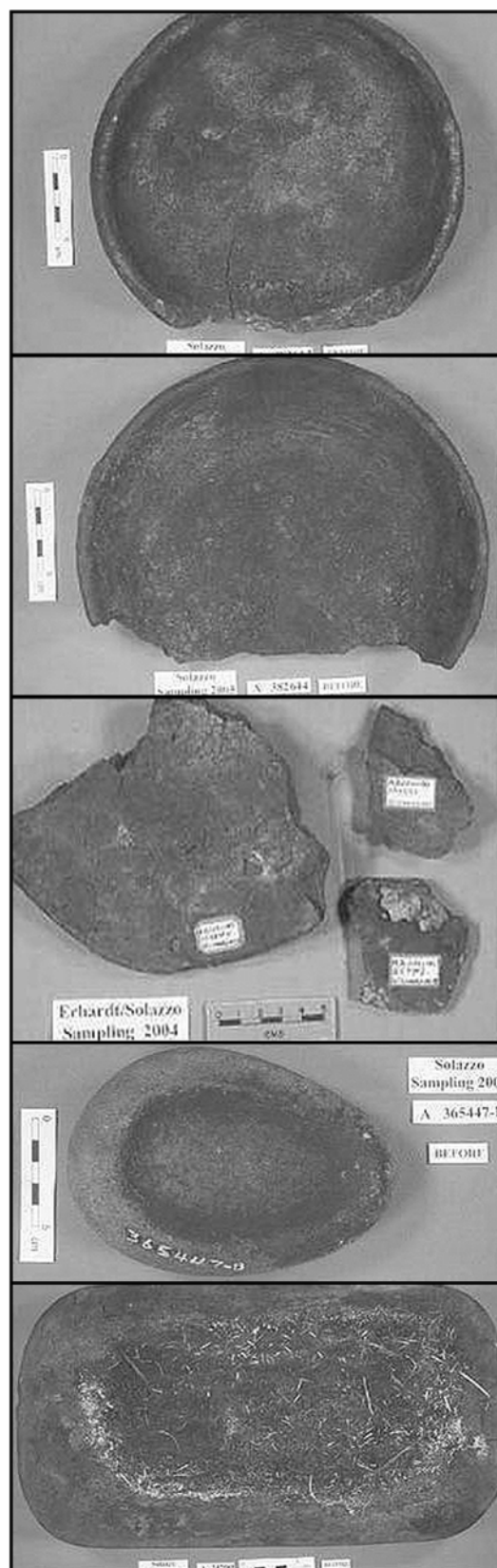


Figure 1: Examples of artifacts from which residues were taken. From top to bottom: saucer-shaped clay lamps numbers 382643 and 382644 from Nunivak Island, potsherds from Miyowagh on St. Lawrence Island, soapstone lamp number 365447 from Kodiak Island and wooden dish number 342583 from the vicinity of Wales.