1996-1997 Activities of CAPE (Circum-Arctic PaleoEnvironments)

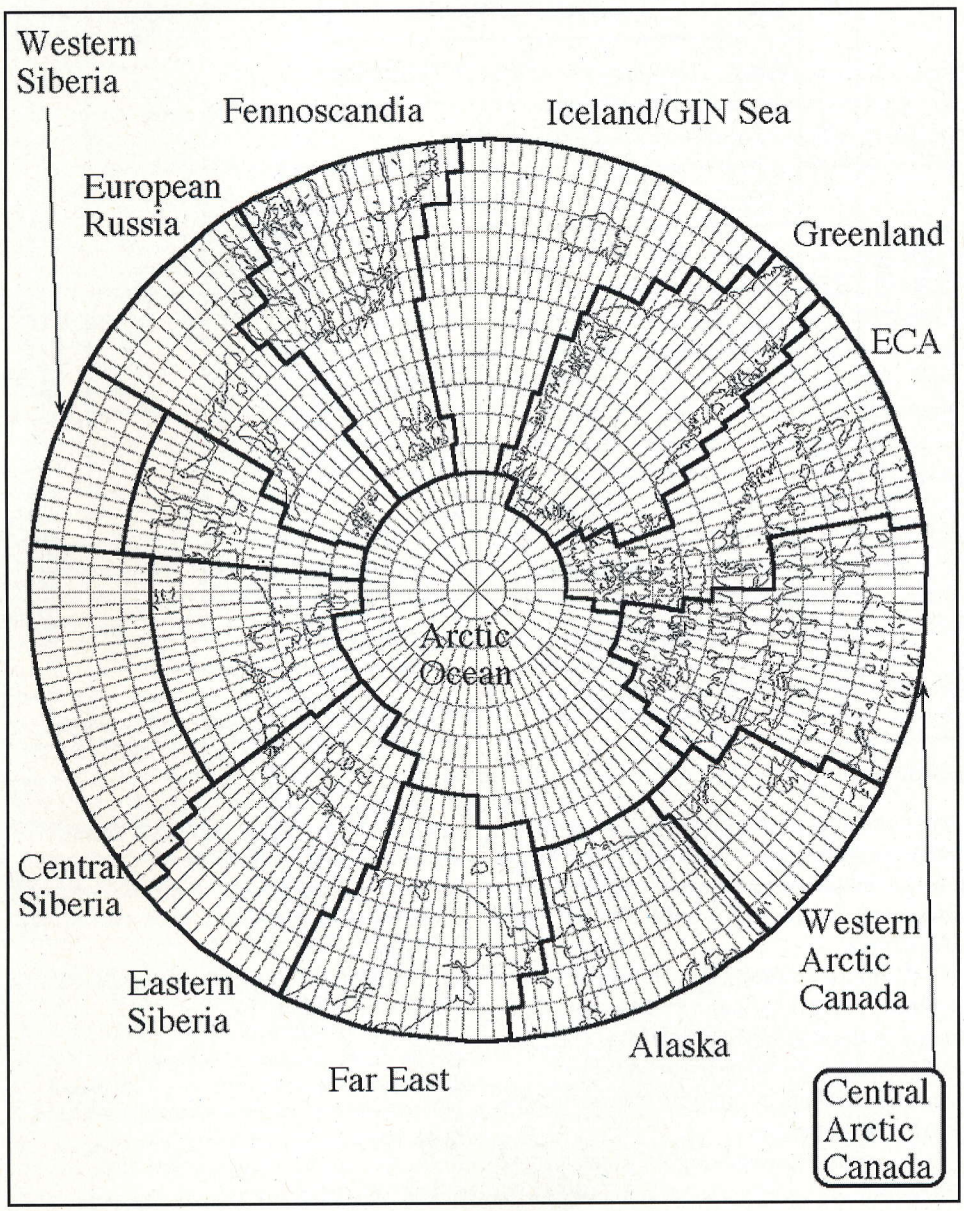
CAPE (Circum-Arctic PaleoEnvironments), is a Project within IGBP-PAGES with a central mandate to link international and national Arctic paleo-programs, and to provide a forum for regional syntheses and modeling, particularly those tasks that cannot be easily achieved by individual investigators or even regionally-focused research teams. The emphasis of CAPE is on paleoenvironmental reconstructions covering the last 250,000 years of Earth history, concentrating on circum-arctic terrestrial environments and adjacent continental margins. The primary mechanism by which CAPE will perform its role is through a series of tightly focussed workshops that address specific topics identified by the community as key to our understanding of the role of the Arctic in the climate system.

The CAPE Holocene Project

The first task identified by CAPE was to define the spatial and temporal patterns of environmental change in the Arctic during the Holocene. With a rich and diverse set of proxy data available in a continuous, or near-continuous time series, the Holocene offers possibilities for paleoenvironmental reconstruction at a level of precision unavailable for earlier periods. The Holocene includes the interval of instrumental and written records, thus allowing a firmly-based calibration of proxy data in terms of climate variables, and it overlaps with the period of rapidly increasing CO_2 content in the atmosphere, a significant feature to be evaluated when predicting future climate change.

A wide range of terrestrial and marine proxies exist as time series for the Holocene. Our goal was to synthesize these time series to characterize the Earth's surface in the Arctic at 1 ka time slices through the Holocene. On land, reconstructions were based primarily on paleovegetation data (pollen and macrofossils) interpreted in terms of a limited number of vegetation types. Other surface characteristics include the distribution of lakes and glacier ice, and paleoshorelines. Additional terrestrial paleoenvironmental data are available less commonly from ice cores and tree rings, and diagnostic changes in isotope data in lakes, aerial plankton, diatoms, and various other faunal and floral elements. Key marine characteristics are the seasonal and permanent sea ice distribution, sea surface temperature (SST), water mass type (e.g. Polar versus Atlantic/Pacific) and dominant currents. A key

Fig. 1: CAPE Regional Subdivisions



CAPE Holocene Meeting Regional Co-ordinators

REGION 1: FENNSCANDIA
Terrestrial: Sheila Hicks, U. of Oulu, Finland
Marine: Morten Hald - U. of Tromso, Norway

REGION 2: EUROPEAN ARCTIC
Terrestrial: Valeri Astakov and Andrei Andreev
Marine: Yugene Musatov

REGION 3: WEST SIBERIA
Terrestrial: Dmitri Bolshyana and Olga Borisova, Arctic & Atlantic Institute, St. Ptersburg
Marine: Vladimir Zarhidze and Yugene Musatov, Russian Institute of Arctic Geology, St. Petersburg, Russia

REGION 4: CENTRAL SIBERIA
Terrestrial: Hans Hubberton
Marine: Heidi Kassens

REGION 5: EASTERN SIBERIA
Terrestrial: Veteslav Markeev and Nicolai Romanoski
Marine: Heidi Kassens

REGION 6: FAR EAST RUSSIA
Terrestrial: Anatolya Lochkin
Marine: Yugene Musatov and Glen Jones

REGION 7: ALASKA
Terrestrial: Linda Brubaker, U. Washington, WA, USA
Marine: Peter Barnes, USGS, Menlo Park, CA, USA

REGION 8: WESTERN CANADIAN ARCTIC
Terrestrial: Les Cwynar
Marine: Steve Blasco, Geol. Survey Canada, Atlantic, Dartmouth, NS, Canada

REGION 9: CENTRAL CANADIAN ARCTIC
Terrestrial: Glen MacDonald, UCLA, CA, USA and Konrad Gajewski, U. Laval, Quebec, Canada
Marine: Art Dyke, GSC Ottawa, Ottawa, Ontario, Canada and Peta Mudie, GSC Atlantic, Dartmouth, NS, Canada

REGION 10: EASTERN CANADIAN ARCTIC
Terrestrial: Gifford Miller, Univ. of Colorado/ INSTAAR, CO, USA
Marine: John Andrews, Univ. of Colorado/INSTAAR, CO, USA and Peta Mudie, GSC Atlantic, Dartmouth, NS, Canada

REGION 11: GREENLAND
Terrestrial: Ole Bennike, DGU, Copenhagen, Denmark
Marine: Rudiger Stein, AWI, Bremerhaven, Germany

REGION 12: ICELAND
Terrestrial: Aslaug Geirsdottir, Univ. of Iceland, Iceland
Marine: Aslaug Geirsdottir, Univ. of Iceland, Iceland

element of CAPE is to ensure that the syntheses are data-based, with full documentation of the sources, and archiving of the primary data in one of the international paleoenvironmental databases.

The Lammi Meeting

The first meeting of the CAPE Holocene Project was held in Lammi, Finland on 4-8 April 1997. Nearly 40 scientists from Canada, Denmark, Finland, Germany, Iceland, Norway, Russia, Sweden, United Kingdom, and the United States, who are currently active in Arctic research attended the meeting. To synthesize the vast array of observational data, twelve regional working groups were established in Fall, 1996 (Fig. 1). For each region, individuals were recruited to lead the marine and terrestrial compilations. As regional compilations were completed, the data were entered into digital spreadsheets so that the regional syntheses could be compiled for the entire Arctic and compared to model simulations in real time during the meeting. At the Lammi meeting, the participants evaluated the spatial patterns of vegetation reconstructions and inferred summer temperatures in 1ka time slices, concentrating on the 10ka and 6 ka time slices. For these times GCM summer temperature anomalies and reconstructed vegetation from the NCAR-GENESIS-EVE and/or BIOME 6000 models are available for comparison. Marine reconstructions of SST were begun, but were hampered by the limited distribution of well dated cores, the diversity of the proxies used, and the difficulty in differentiating polar water masses outside the area of Atlantic water influence. Color maps of the 6ka and 10 ka GCM temperature anomalies were generated, on which the semi-quantitative estimates of temperature from nearly 400 individual sites were superimposed in a color- and size-coded scheme corresponding to the sign and magnitude of change reconstructed from the proxy data. Strong spatial patterns emerged that are by and large concordant with the GCM simulations.

CAPE Vegetation classification scheme

Vegetation group	Biome			Relative change in summer temp.
Tundra	1		Sparse vegetation / Fellfield	
		1b	Woody species absent	A
		1a	Woody species present	B
	2		Graminoid Tundra	
		2c	Poaceae dominant	C
		2b	Poaceae and Cyperaceae	D
		2a	Poaceae + *Artemisia* + other herbs	
	4		Heath Tundra	E
	5		Shrub-Graminoid Tundra	F
	6		Deciduous Shrub Tundra	G
		6a	*Betula* dominated	
		6b	*Alnus* + *Betula* dominated	
	7		*Pinus pumila*	
Forest/ Tundra	10	10a	Tundra + evergreen (any type)	H
		10b	Tundra + *Larix*	
		10c	Tundra + *Betula*	
		10d	*Populus* woodland	
Forest	13		*Betula* dominant	I & J
	14		*Larix* dominant	
	15		*Picea* dominant ± boreal hardwoods	
	16		*Pinus* dominant ± boreal hardwoods	
	18		Boreal conifers + temperate hardwoods	K

COLDER ↓ WARMER

Accomplishments and Future Directions

The consensus of the participants at the Lammi meeting was that major strides were achieved in the synthesis of the terrestrial data. Particularly encouraging was the development of a consensus scheme to characterize Arctic vegetation by a limited number of biomes (see Table), and the real-time visualization of these reconstructions for the entire Arctic. The marine synthesis was less complete. It was hampered by more complex, multi-proxy datasets, and less comprehensive spatial coverage. The history of sea ice variations, the single most important marine surface parameter remains elusive, although promising data are emerging using marine dinoflagelates as sea-ice proxies. However, few high-resolution Holocene records for the Arctic have been developed.

A follow-up meeting will be held within the next 18 months, and a journal issue dedicated to the regional compilations and pan-Arctic synthesis will be a final product.
For more detailed information, please visit the CAPE Homepage at :
http://www.ngdc.noaa.gov/paleo/cape/TOC.htm.

Two new CAPE projects will be initiated within the next 18 months:
1) A high-resolution synthesis of the last 1ka to 2 ka, addressing seasonal to decadal climate change,
2) Synthesis of the Last Glacial Maximum (LGM), ca. 25ka to 10ka.

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