Airborne Geophysics Evolution 1945-2006

USGS aeromag plane-1945

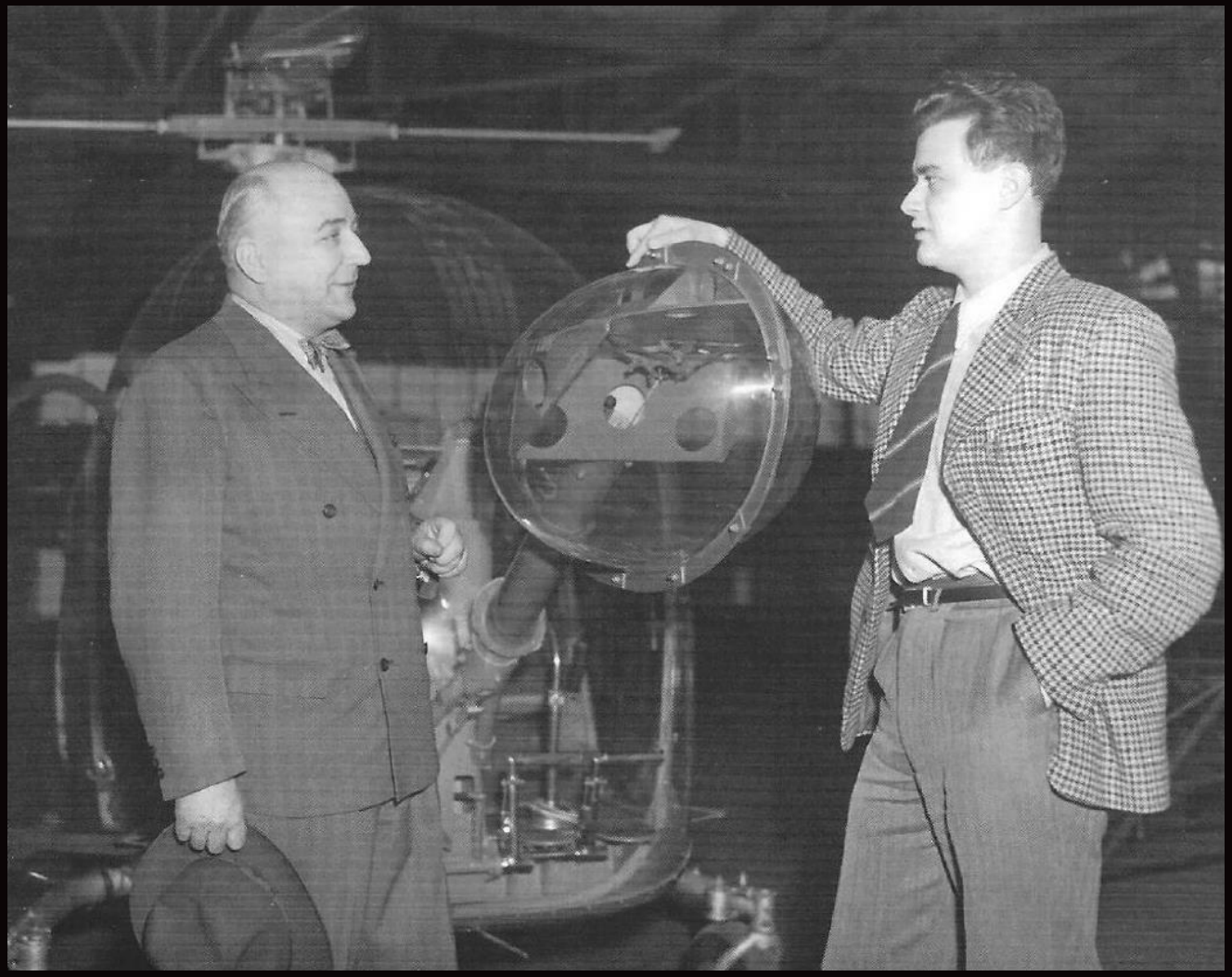

U.S. Navy aircraft used for
1945/1946 aeromagnetic survey
of the National Petroleum Reserve,
Alaska

USGS 1945-46

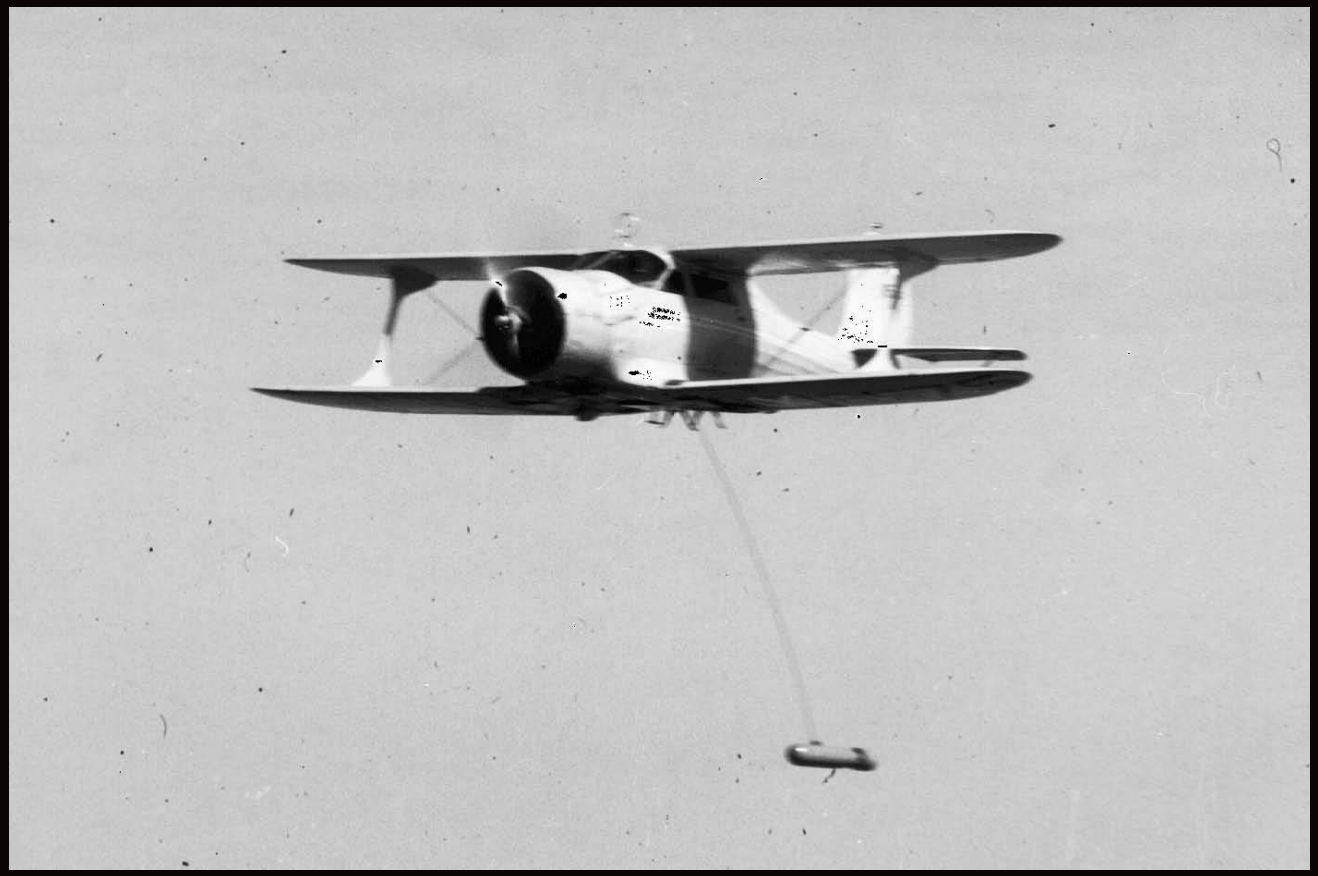
Jay Demming, Bell Aircraft pilot, awaits Hans Lundberg before taking off to survey the area around Amos, Quebec, with the electromagnetic equipment in the nose of this helicopter.

Hans Lundberg
Heli-EM System, 1946

Hans Lundberg
First heliMag system
1947



Hans & Sten Lundberg with heliMag, 1947



USGS towed bird mag system-1947

Mimi Hill in USGS mag plane-1947

USGS mag crew-
Mimi Hill (far right)

Lundberg heliMag system-1948

Fig. 5

ANSON V PLANE

SHOWING POWER COIL

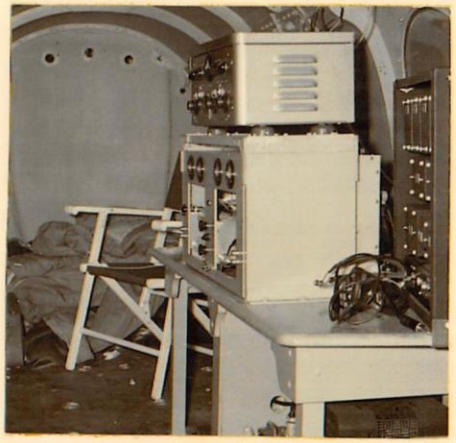


Fig. 6

INTERIOR

LOOKING AFT

I

LOOK

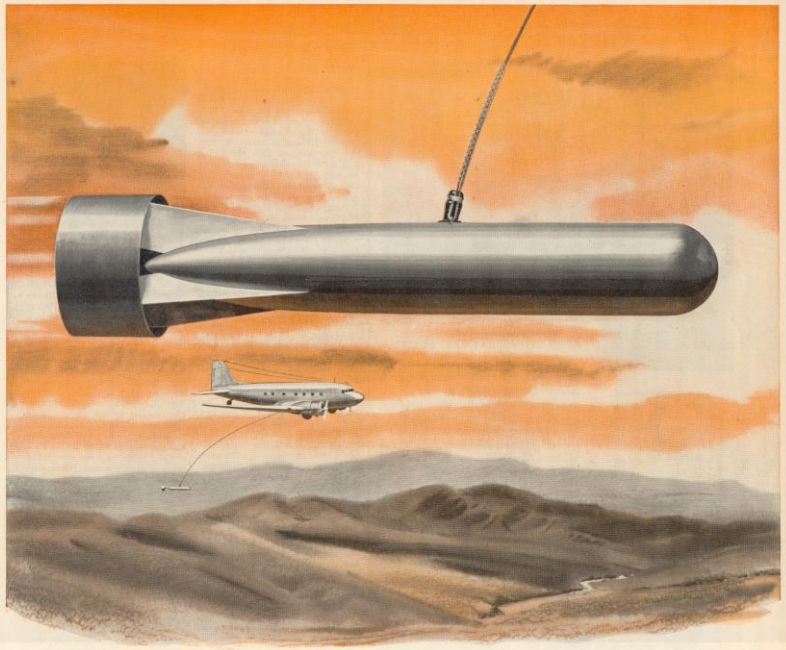
Lundberg-Conoco AEM system 1949

1st Successful Airborne EM!

Stanmac/McPhar on Anson, July 1948

W.A. Robinson (McPhar), Stanley Davidson - geologist, H.A. Harvey (McPhar), J.A. Syme - pilot geologist.

Kennecott aeromag system-1952



Miner in the sky

The old prospector and his burro are gone. Scientific tools help the modern prospector do a better, faster job. He can even detect iron ore from the sky using a magnetometer suspended from a plane.

Kennecott prospectors have uncovered new sources of titanium in Canada. In Africa, in South America and here at home, it is an important part of our job to maintain a constant search for new sources of metals.

Along with our exploration goes a program of continuous research to increase the recovery of metal from the ore of already established mines. By extending the life of these mines . . . as well as by discovering new ones, Kennecott helps to insure a constant flow of the metals so vital to the nation.

KENNECOTT
COPPER CORPORATION

Fabricating Subsidiaries:
CHASE BRASS & COPPER CO. • KENNECOTT WIRE & CABLE CO.

ABEM 2 Aircraft AEM System, 1955


NUCOM, 1955
1st Helicopter towed boom

Spartan Rio Mullard Otter EM on Beaver, 1956

Rio Tinto –Mullard, on Beaver, 1956 Champion – Don Wagg RioCanex

Spartan AEM on ANSON, 1957

Spartan Air Services was hired in 1957 to fly the Cape Smith Belt for a group of companies. First survey of its kind.

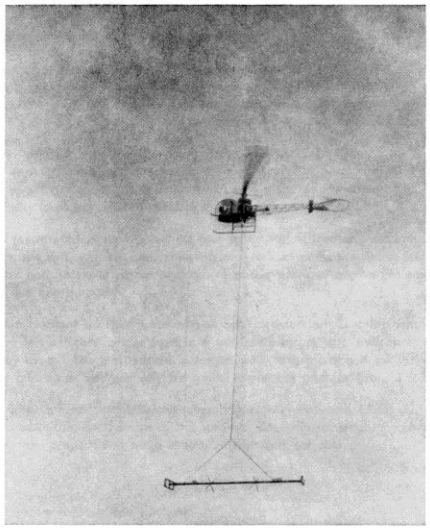
Newmont/Varian/Aero on Sikorsky, 1957

Newmont/Varian/Aero on Sikorsky, 1957 (Dick Butler)

Sander HEM advert-1958

GEORGE SANDER LTD.

174 Douglas Ave. Oakville, Ontario Phone VI 4-6345



Helicopter Borne Electromagnetic Instrument

of GEORGE SANDER LTD.

1958

INCO’s Vic Kanerva, 1959

Austin’s Mark Nieminen, 1959

INCO McPhar, on ANSON late 1950s

Barringer INPUT on Canso, 1959


McPhar AFMAG, on ANSON 1959

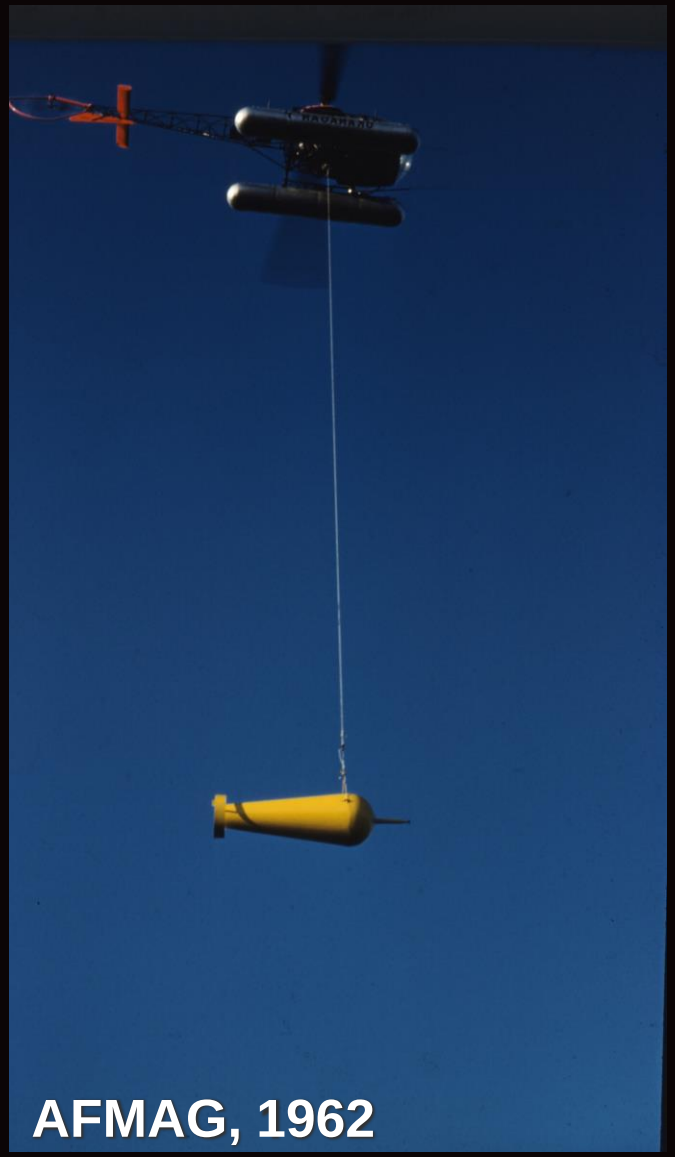

Texas Gulf-Varian on Hiller 12E, 1959

Texas Gulf-Varian on Hiller 12E, 1959

Canadian Aero Nose Tail EM on Canso, 1960

Canadian Aero on Canso, 1960


INCO Anson, 1962
Ed Morrison
75
75


AFMAG, 1962

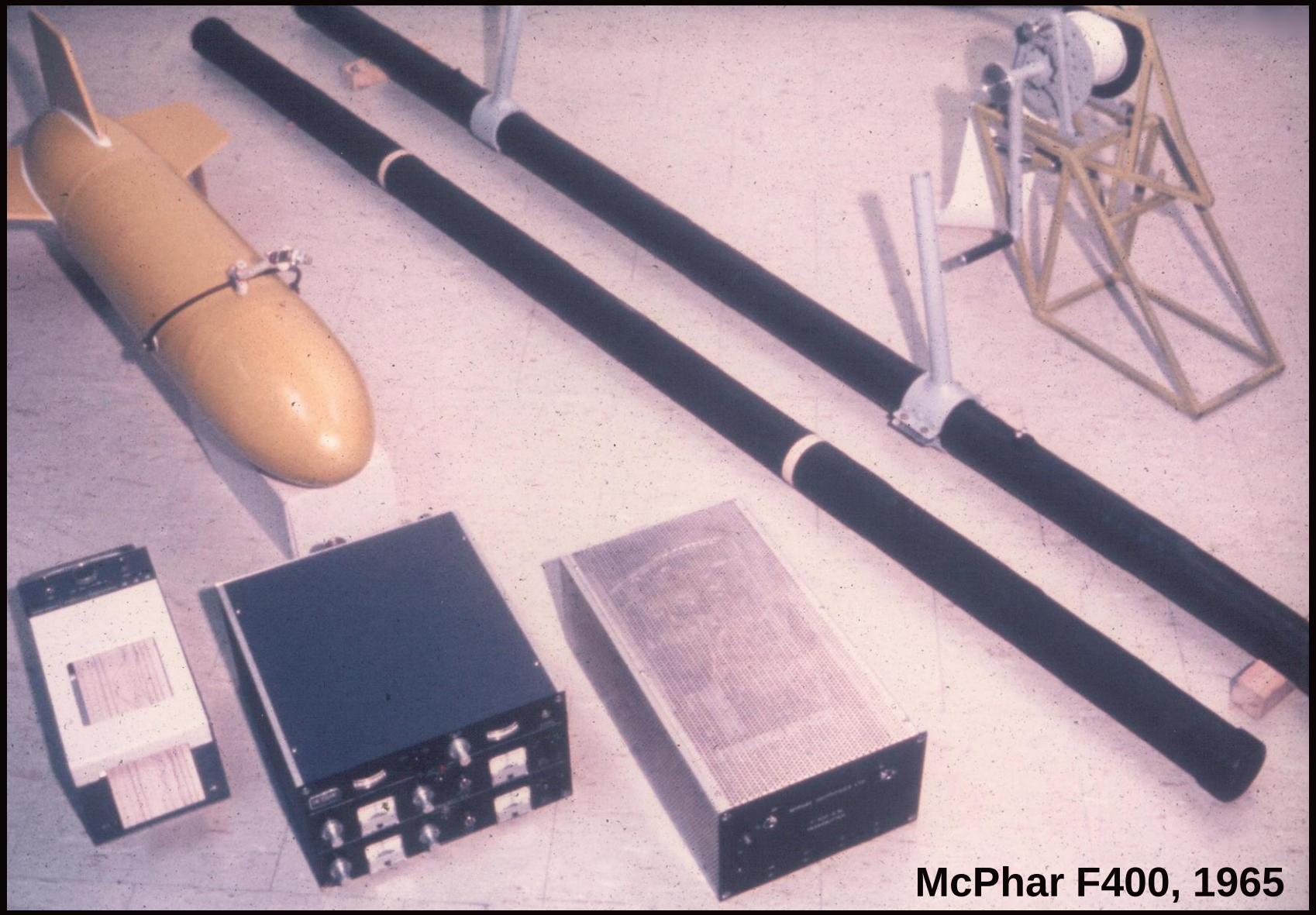

INCO Anson, 1963


INCO Anson, 1963

Adastra-Hunting on DC-3, Australia 1963

INCO/AUSTIN crew, 1963

Geophysical Engineering EM System on Beaver, 1964

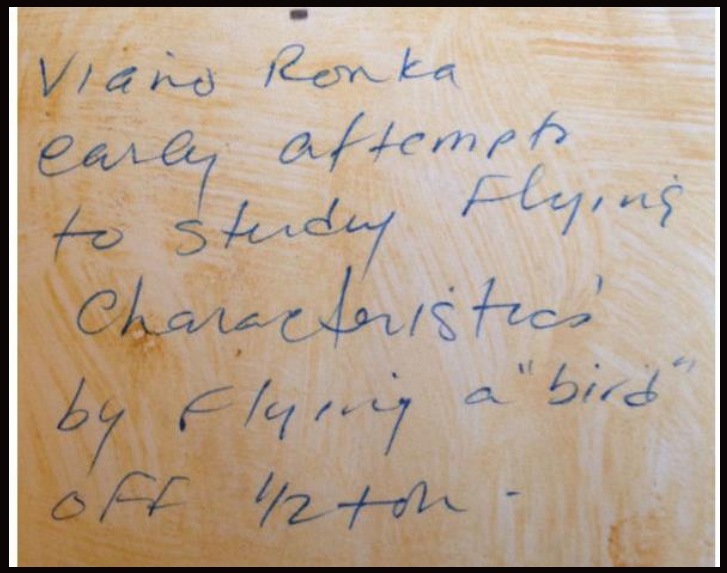


McPhar F400, 1965

Barringer Mk-5 INPUT Systems Trials on Canso, 1965

Barringer INPUT System on USGS Covair-1965


AFMAG, 1965



Vaino Ronka & 'natural 'wind tunnel'-1965

1st Input European Demonstration in France, 1965

Reg Cruickshank, Francis Kivinen

Barringer staff with CGG in France for INPUT trials,1965


Neil Dick, Reg Cruickshank, for European
Demonstration in Ireland 1965

INCO Anson, 1966

INCO ANSON System, 1966

McPhar AFMAG on Cessna, 1967

McPhar AFMAG on Cessna, 1967

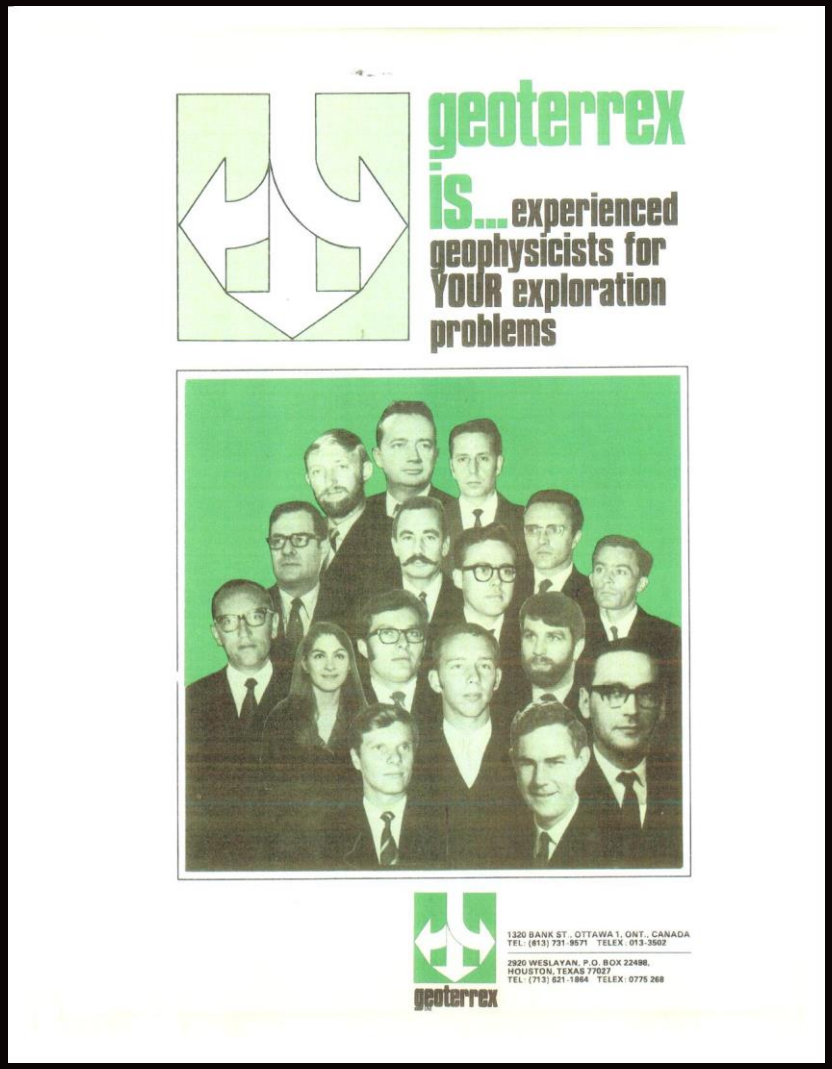
McPhar F400 on Beaver, 1967


Barringer Null-Coupled, 1967
CF-TGP
KEEVIL MINING GROUP
TORONTO, ONTARIO
Reg Revard, Reg Watts, Ed Morrison, & Bill Edwards


Mario Steiner, 1967


Ed Morrison, 1967

McPhar AFMAG on Cessna, 1967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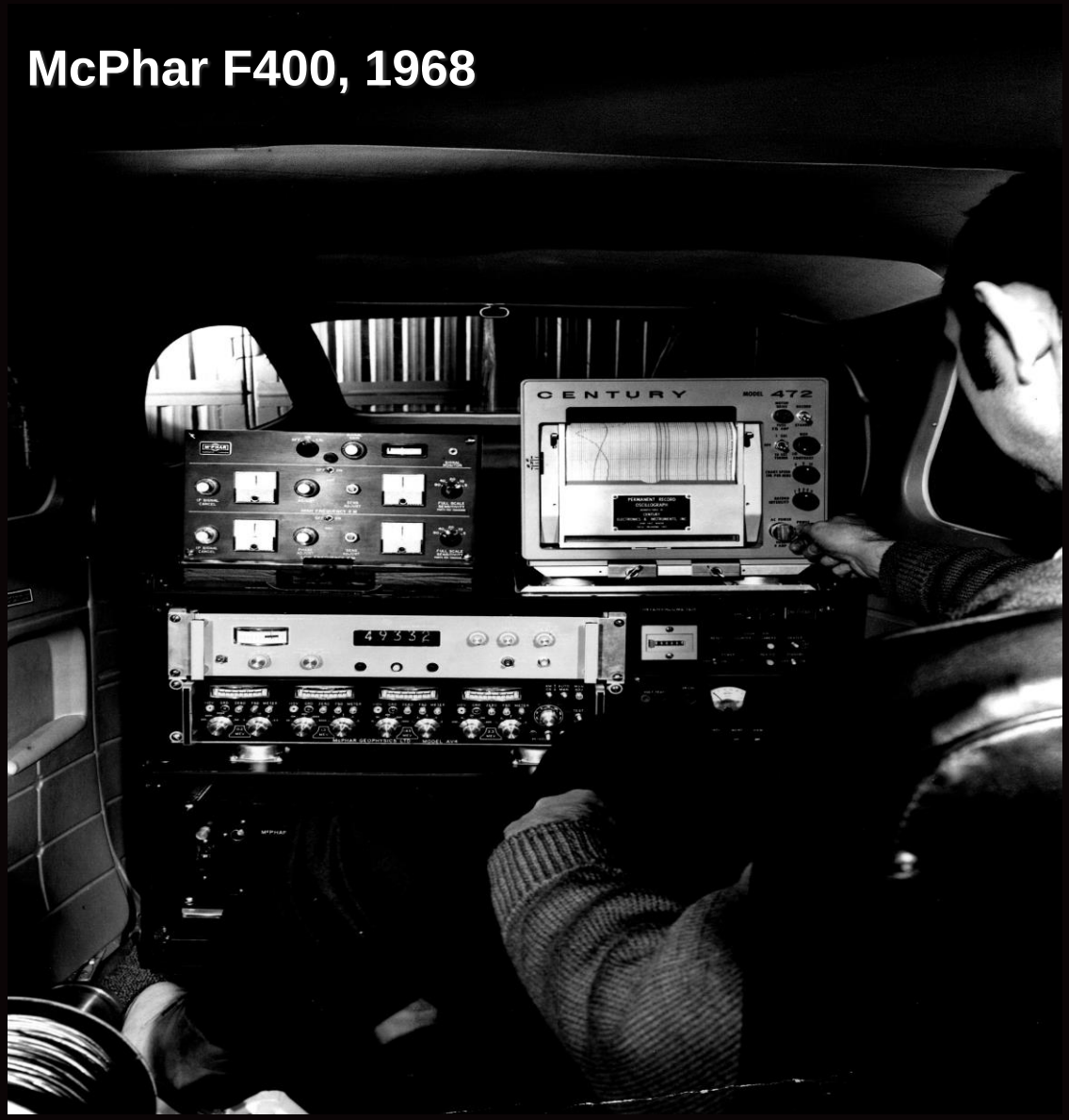
Peer Norgaard, Michel Jacquemin, Art Rattew
Don Wagg, Michel Utard, Rolf Pedersen, Ian Fraser, Jacques Leridon
Horst Stoltz
Mike Reford
Ivo Tyl, anon, Roman Wasylechko, Wolf Tscaikowsky, Peter Gunn, Aime Brazeau

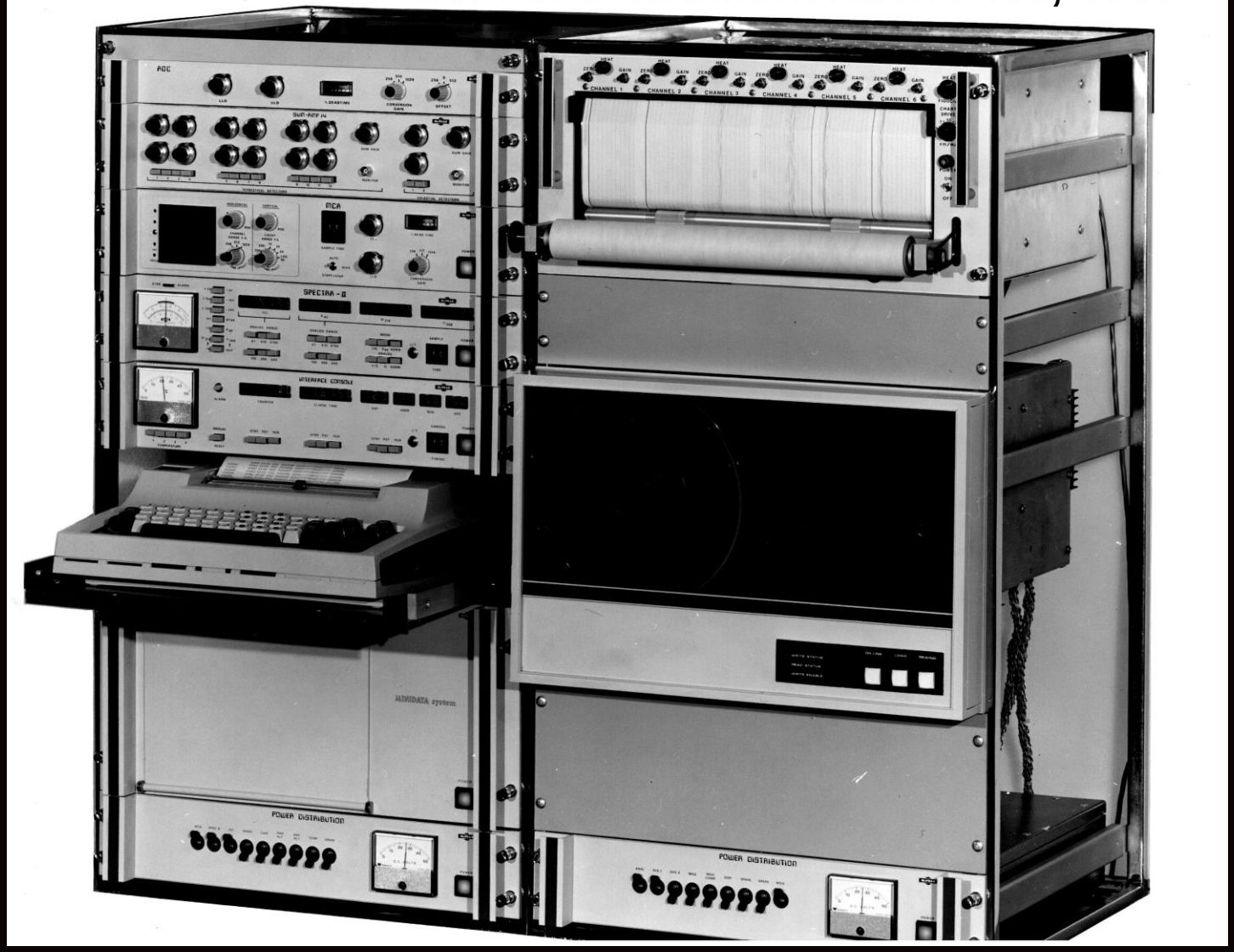
First heliTEM developed at NGRI (USSR)-1967

Barringer crew field testing prototype, 1968

McPhar F400, 1968

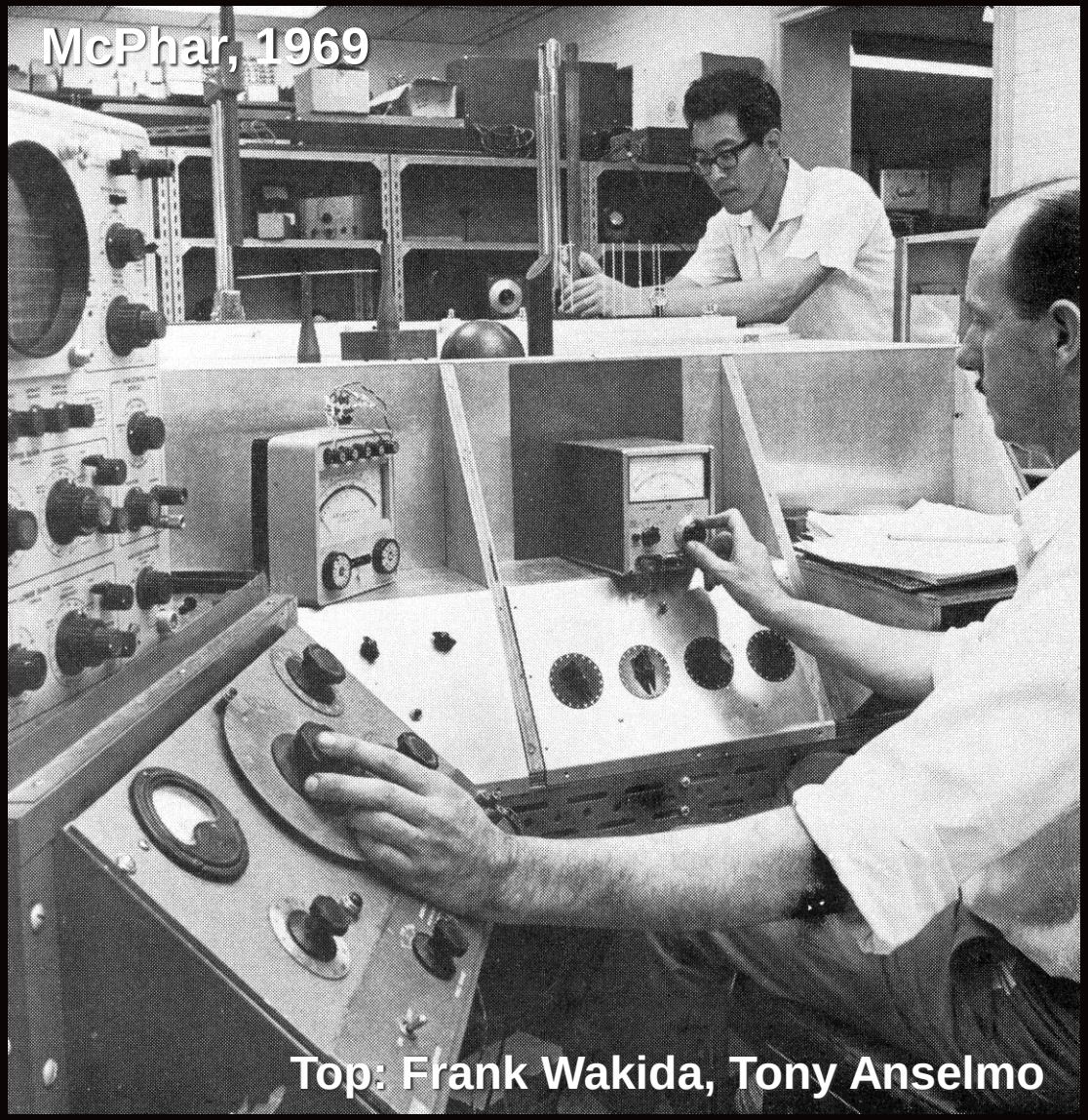


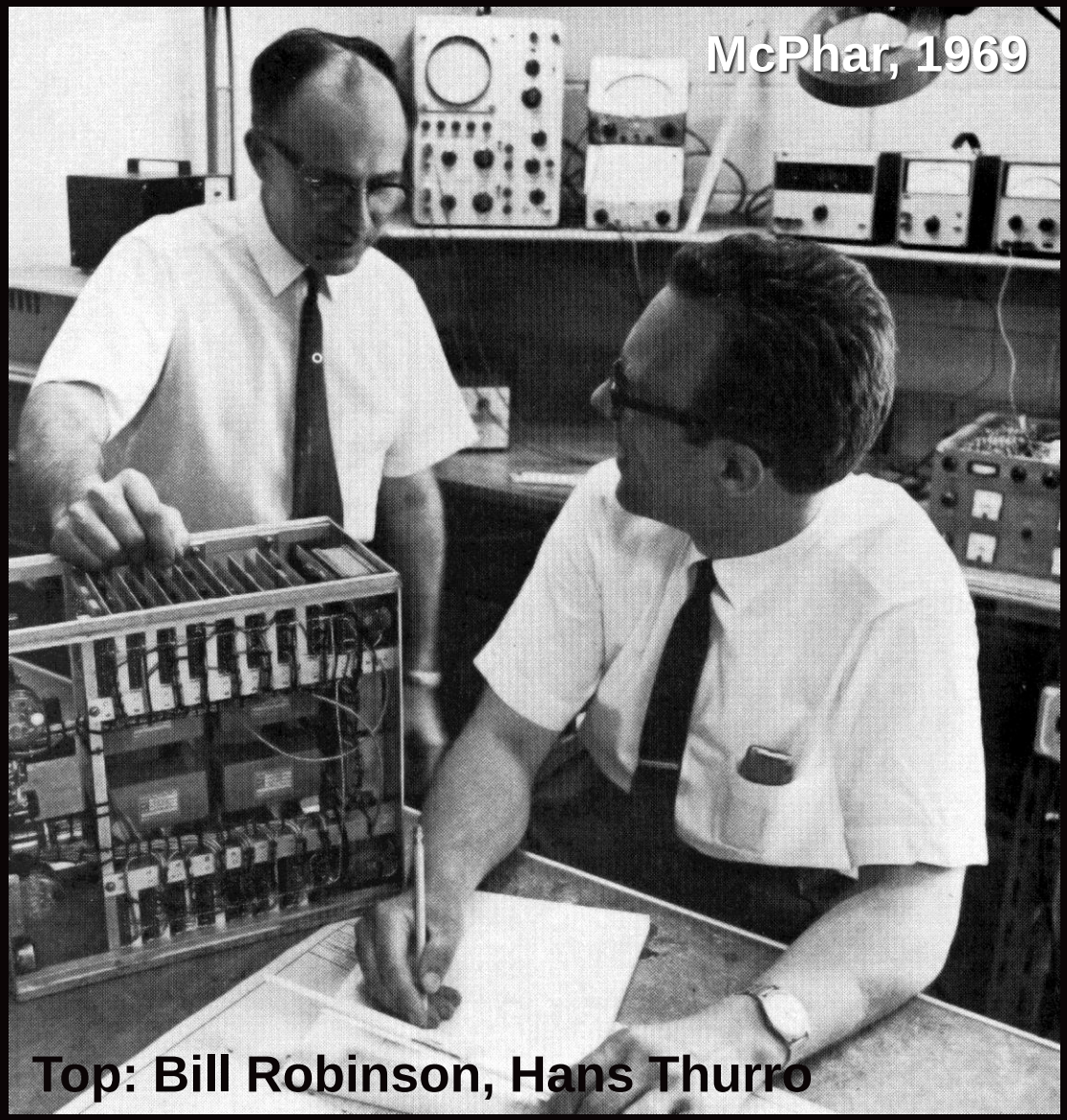
McPhar Instrument Rack F400, 1968




Ed Morrison
McPhar, 1969


McPhar, 1969


McPhar, 1969
Top: Frank Wakida, Tony Anselmo


McPhar, 1969
Top: Bill Robinson, Hans Thurro


ANSON, 1969


Geoterrex INPUT on CANSO, 1969

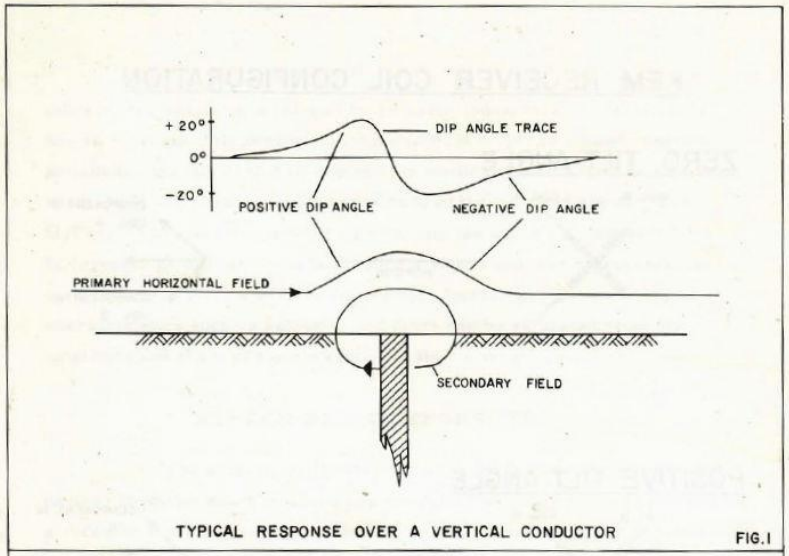
McPhar AFMAG & F400 EM on Beaver, 1969

McPhar F400 on Cessna, 1969

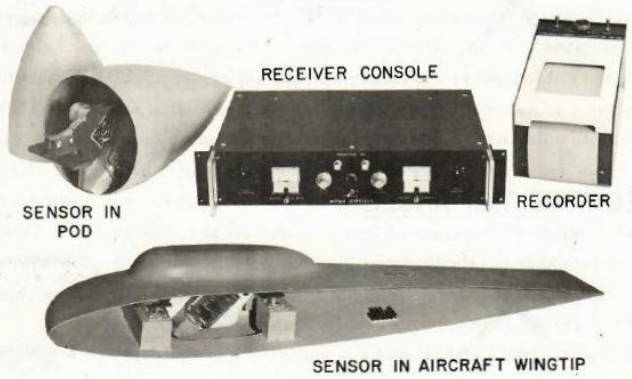
INCO EM system on Twin Otter, 1969

Twin Otter INCO EM system on Twin Otter, 1969

McPhar KEM (VLF) System 1969



TYPICAL RESPONSE OVER A VERTICAL CONDUCTOR FIG.1



McPHAR AIRBORNE KEM SYSTEM FIG.2

Back Row: J. Munroe, B. Caughill, Bill Henderson, R. Dutchburn, Ray Lejeune, W. Evershed, Moe Sears, J. Murphy, H. Tucker, Gary Cook, Alex Fiddler. **In Front**: Paul Wesser, G. Michalak, T. Blatchfor, S. Wojnas, Alex Grzelak, John Wenham.

McPhar machine shop, late 1960s

1 - Frank Tomiola, 2 - Bill Robinson, 3 – Mike McGee

McPhar mag Kalgoorlie on Beaver, 1970

Barringer AirTrace on B-3 1971

Barringer AirTrace Nevada on B-3 1971

QUESTOR INPUT on Skyvan, 1971

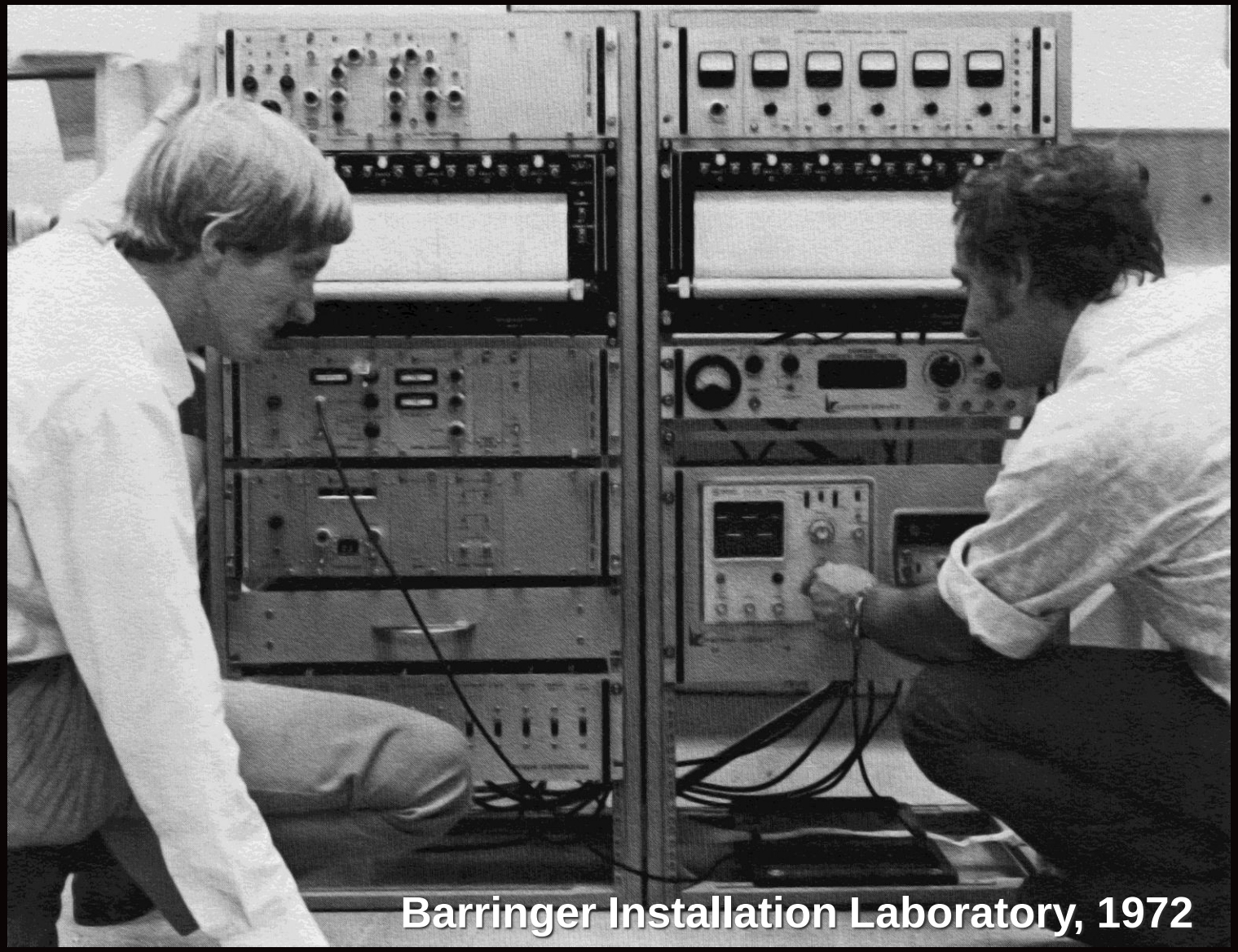

Spartan AERO, 1971

Spartan AERO, 1971

Spartan AERO, 1971

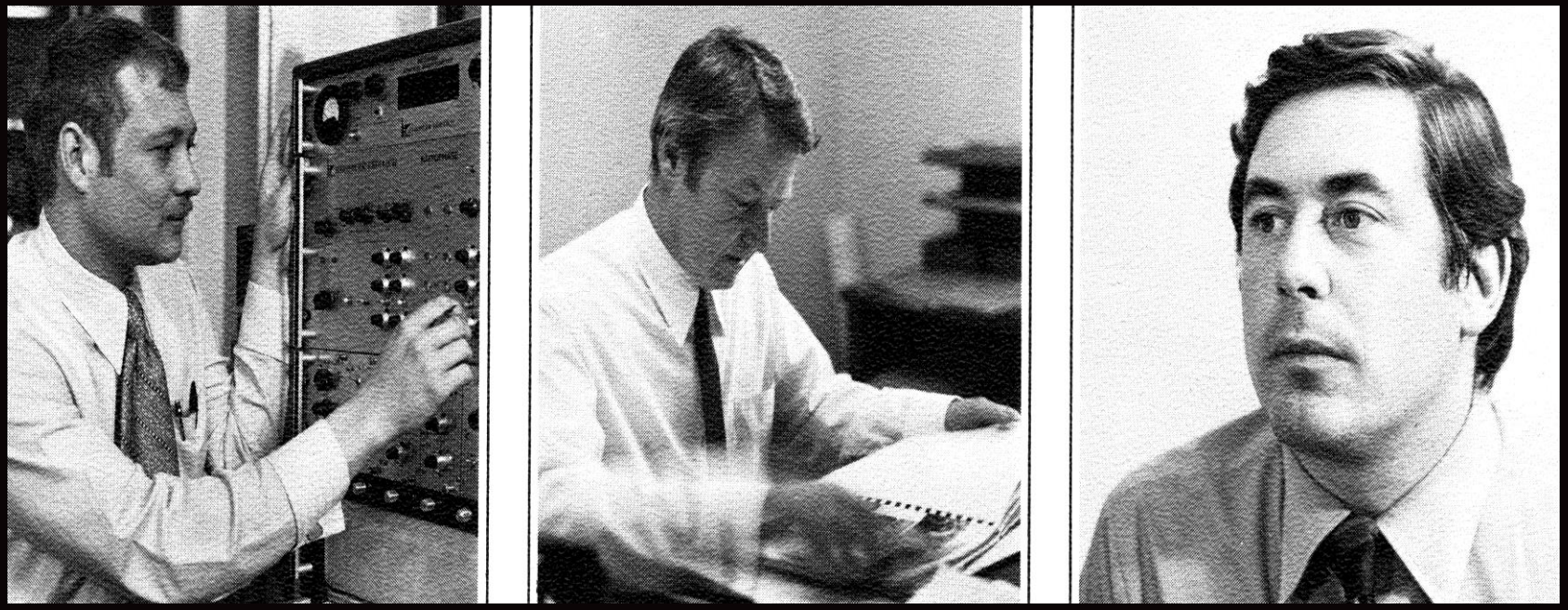
McPhar 400, Australia on Turbo Beaver, 1972

McPhar – H400, Malawi (Africa) on Bell 204, 1972



Barringer Installation Laboratory, 1972

Barringer, 1972



Bob Middleton, David A. Whiteman & Duncan McNeill


AN-2 – USSR Ministry of Geology, 1973
CCCP-06

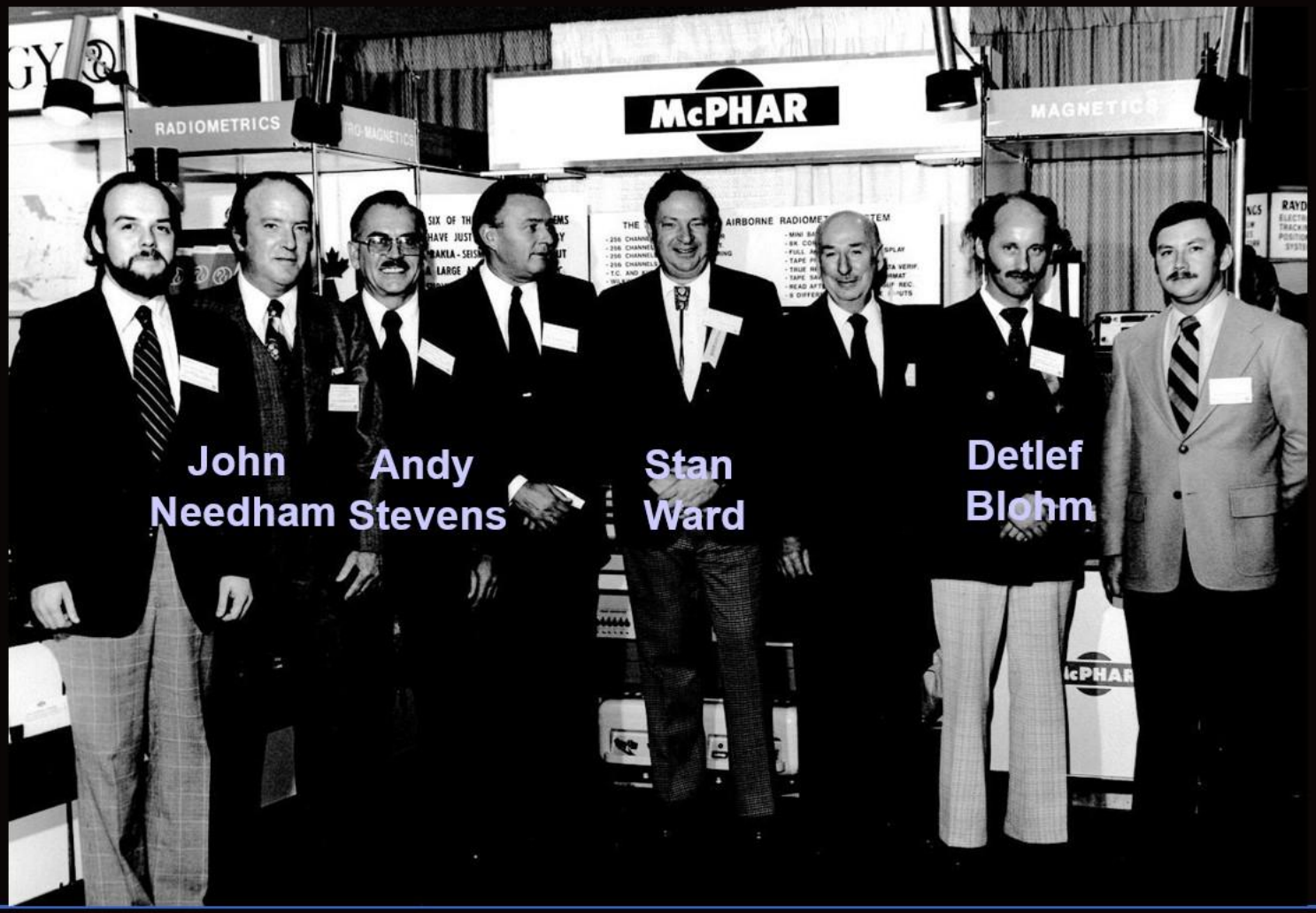
Finland Wing-Tip EM System on DC-3, 1973

Questor INPUT on Trislander, 1973

Anglo American Corp. F400 on DC-3, 1973

McPhar H400 on Hughes 500, 1973

McPhar at PDAC-1974



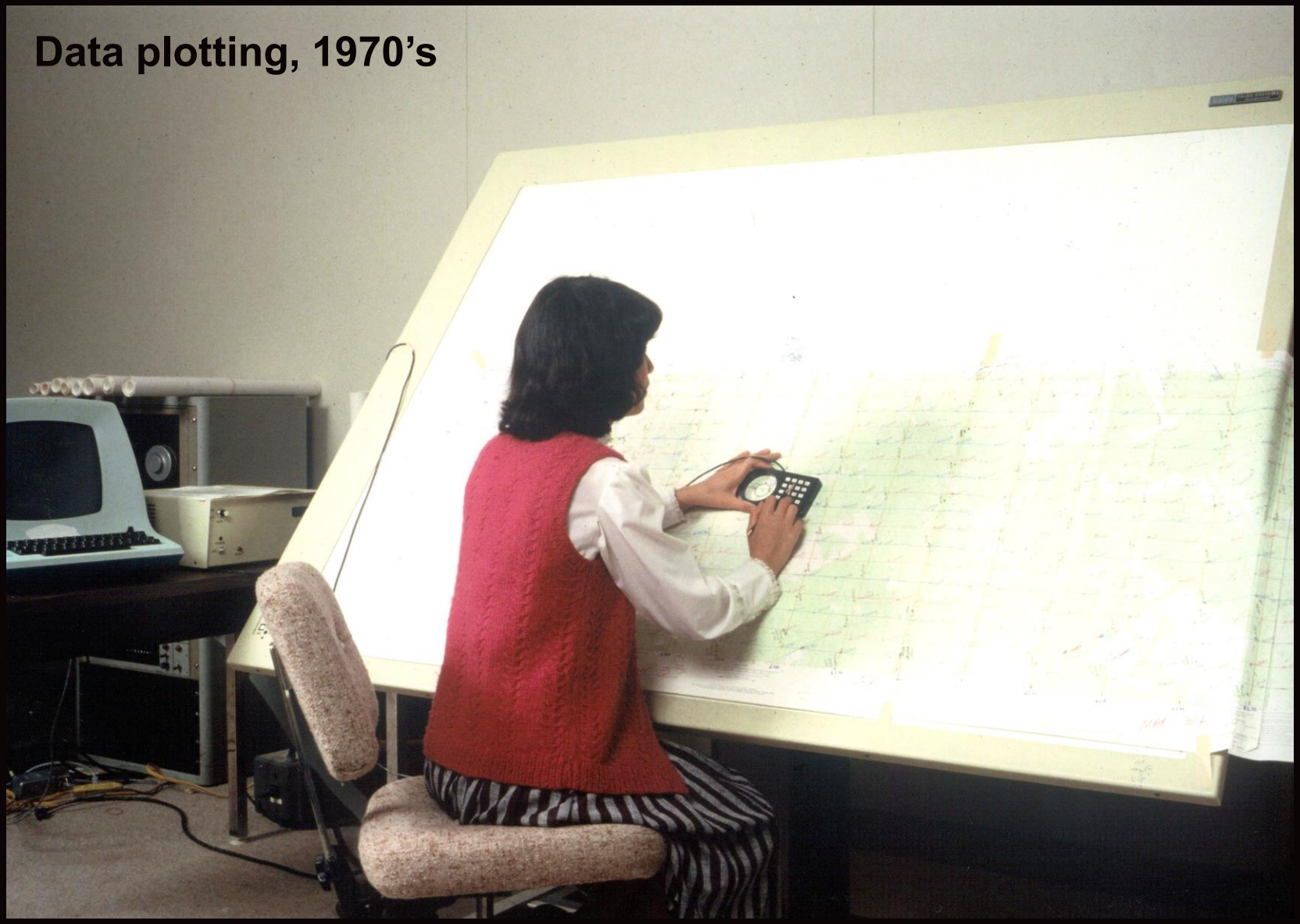
McPhar at PDAC-1974

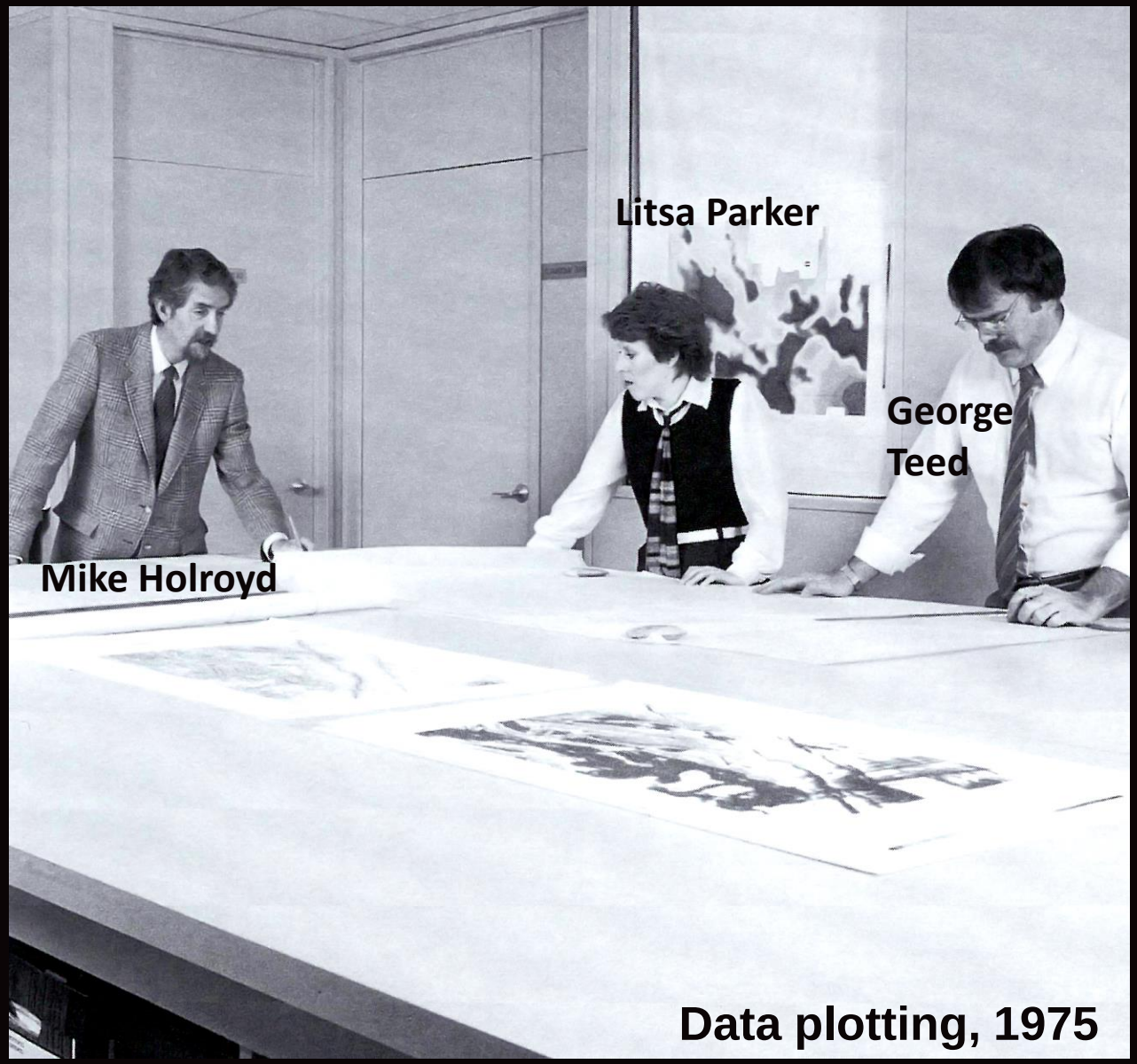

MTA Turkey F400 on DC-3, 1974

George Sander-1975

AMAX-Berkeley SQUID AEM System-1975

Data plotting, 1970's





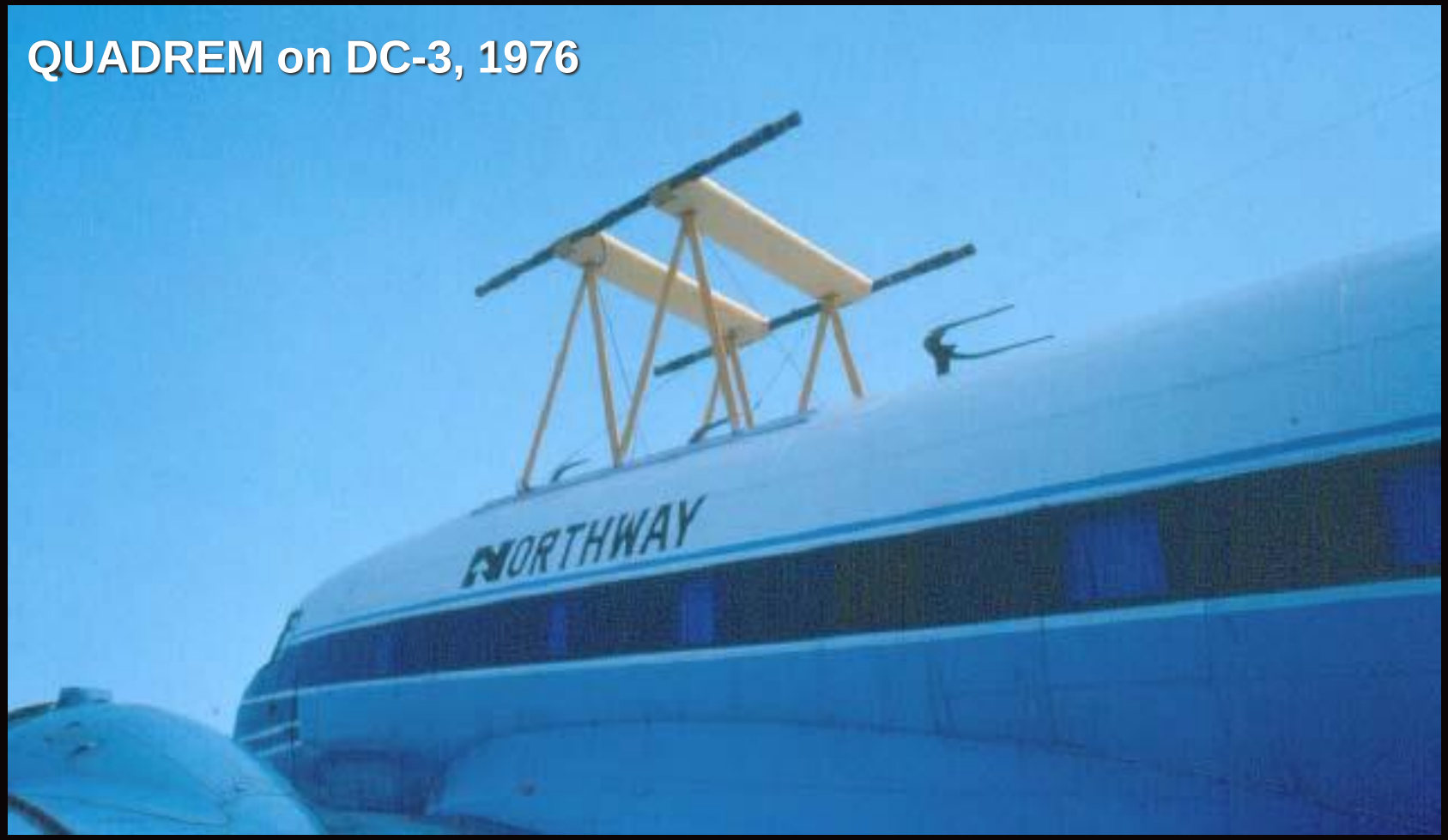
Data plotting, 1975

IGGE, China – Y-5 single freq.,1975

Sander HEM on Bell-1975

QUADREM System on DC-3, 1976

QUADREM – Northway Services on DC-3, 1976


QUADREM on DC-3, 1976
NORTHWAY

Kenting Scintrex TRIDEM on Canso, 1977

Kenting/Scintrex TRIDEM on Canso 1977


Geosurvey TRIDEM on
Twin Otter, 1977
N999PG
Geosurvey


Geotech EMXII, 1982


Questor HeliINPUT on
Bell 205, 1982


IGGE, China – Y-11, 1982

Questor INPUT on DC-3, 1982


Geotech Bathymetry System, 1984

Kenting SWEEPEM on Canso, 1984

Kenting Earth Sciences, 1984

Geotech NORDA System, 1984

Geotech Ice Thickness System, 1985

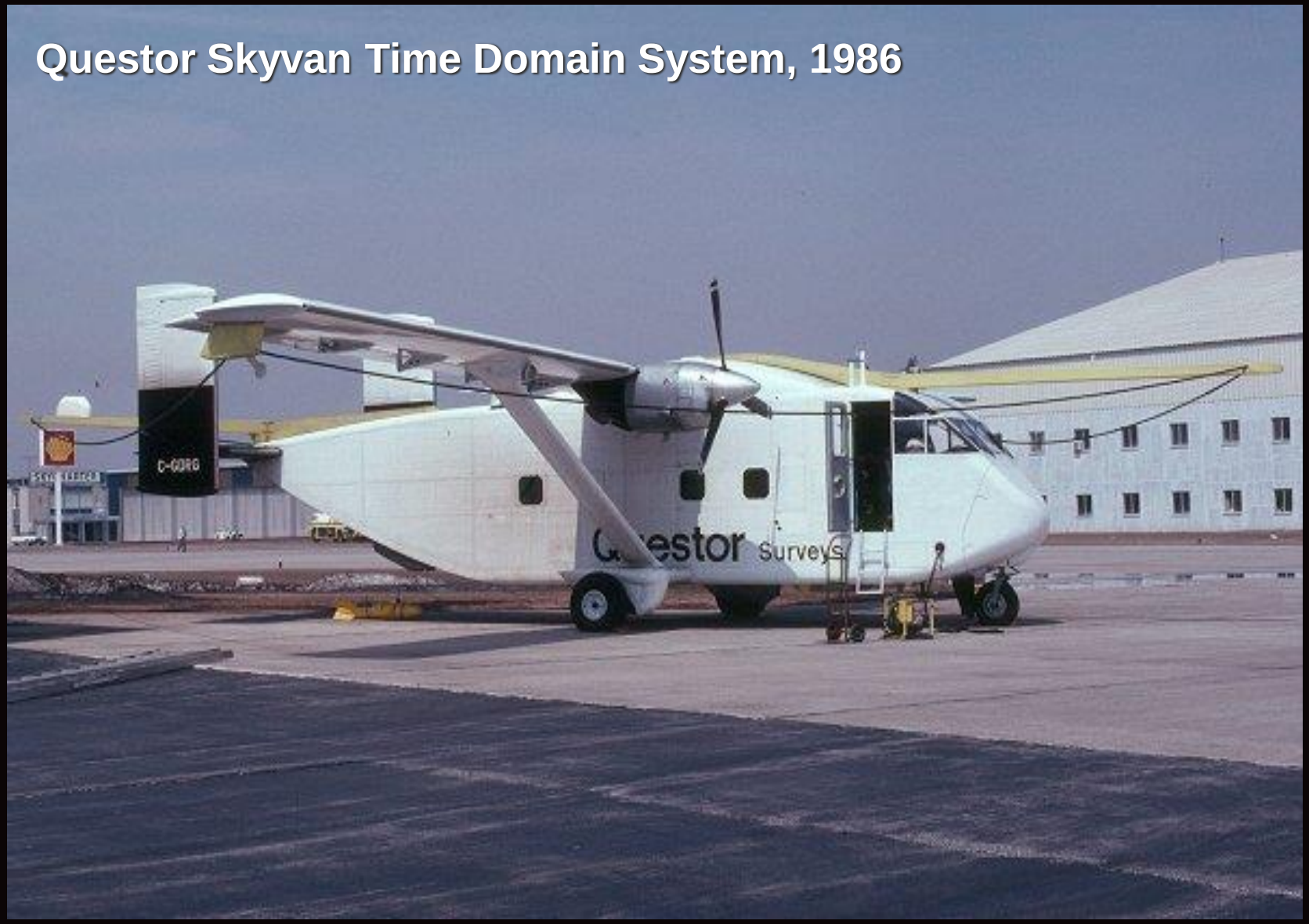

Kenting Gradiometer, 1985
KENTING

GEOTEM CASA, 1985

Questor Helium Magnetic Gradiometer, 1986


Questor
Trislander
System, 1986

Questor Skyvan Time Domain System, 1986

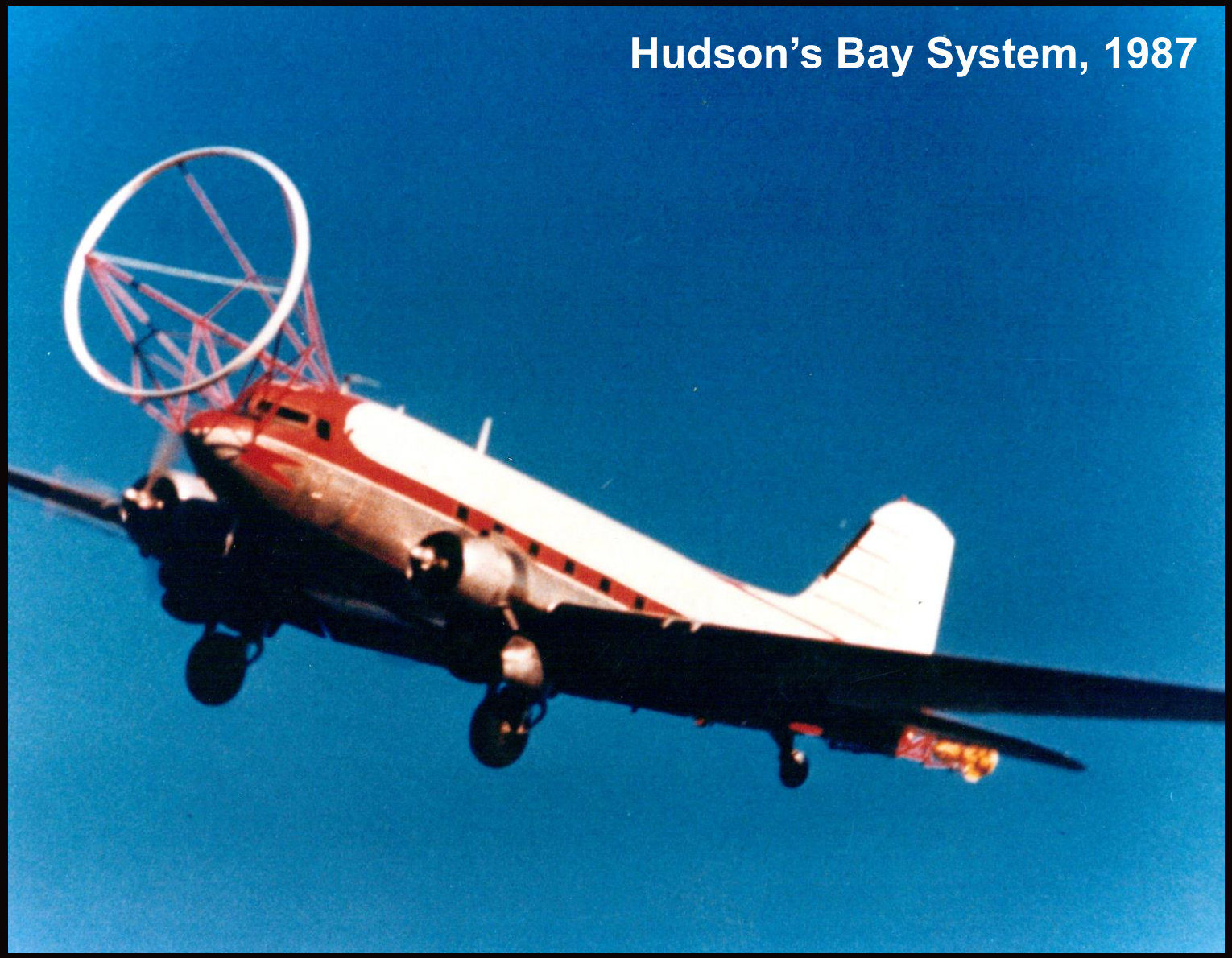



Terraquest Fixed Wing Mag, 1986
ROBERTSON
STOL
C-FAKK
Mike McGee


Vertical Mag Gradiometer, 1987


Aerogeophysica 3-Freq. EM System, 1987
АЭРОФЛОТ

Hudson’s Bay System, 1987


Hudson's Bay System, 1987

Geotech Hummingbird, 1988

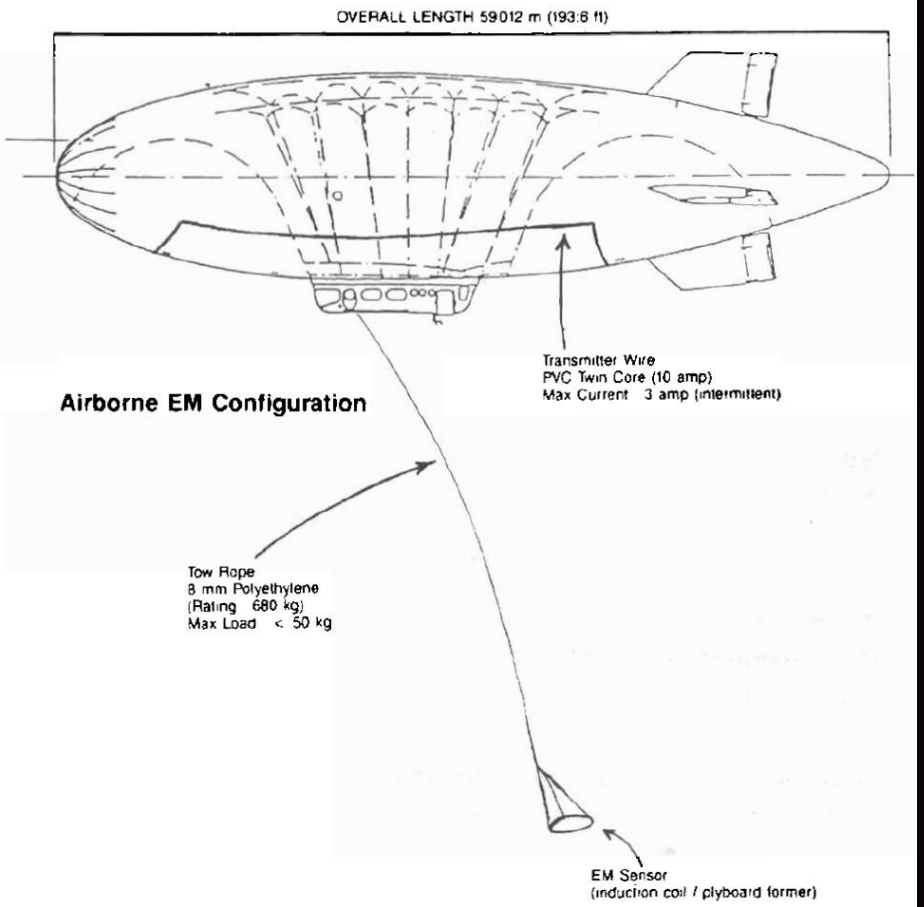
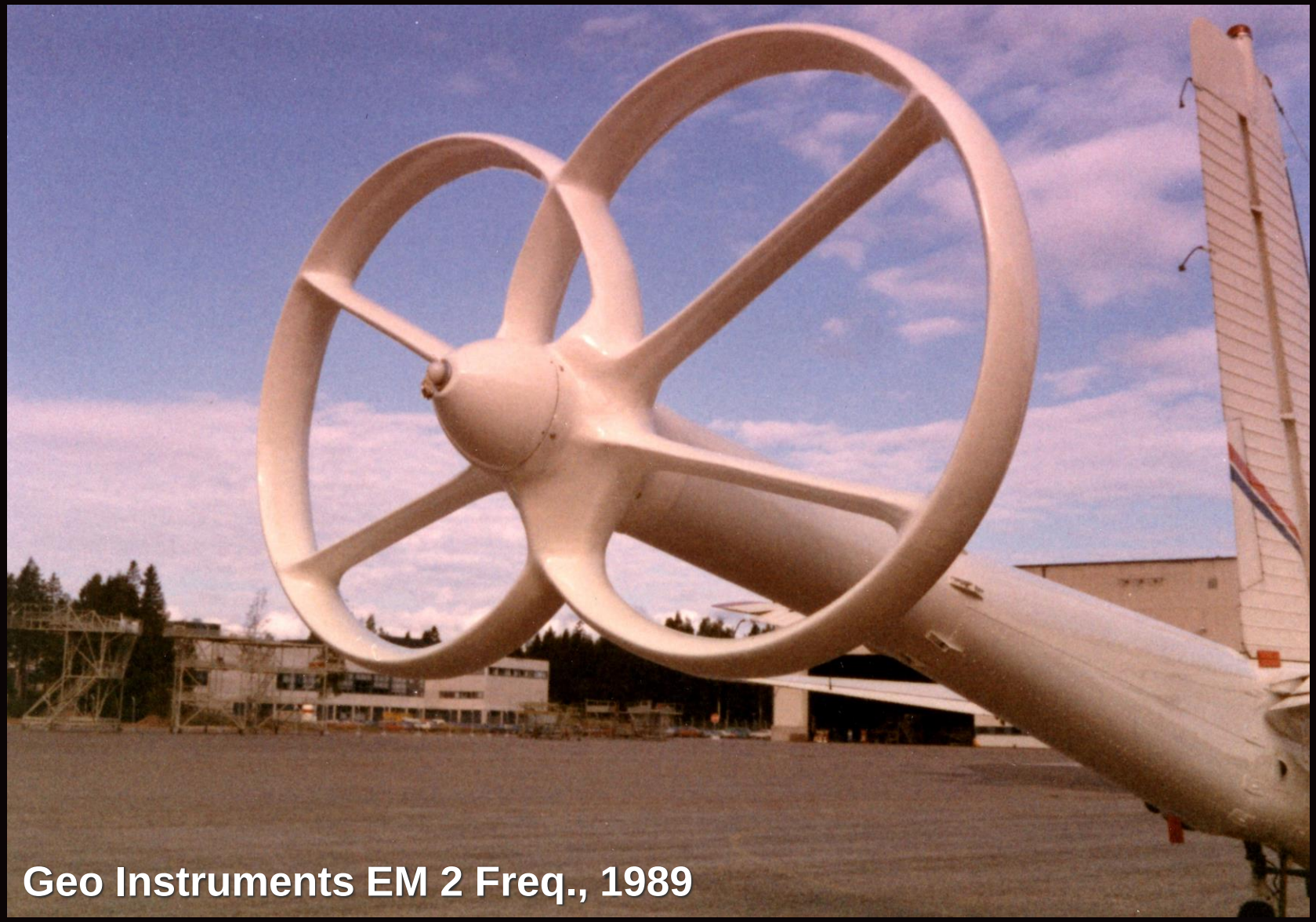


FIGURE 1.
Airborne EM Configuration (standard SIROTEM horizontal loop/RVR)

Blimp-based TEM system-1989



Geo Instruments EM 2 Freq., 1989

Geo Instruments EM 2 Freq., 1989


Geotech Hummingbird 2 Freq, 1989
Neil Punstle & Ryan Raz

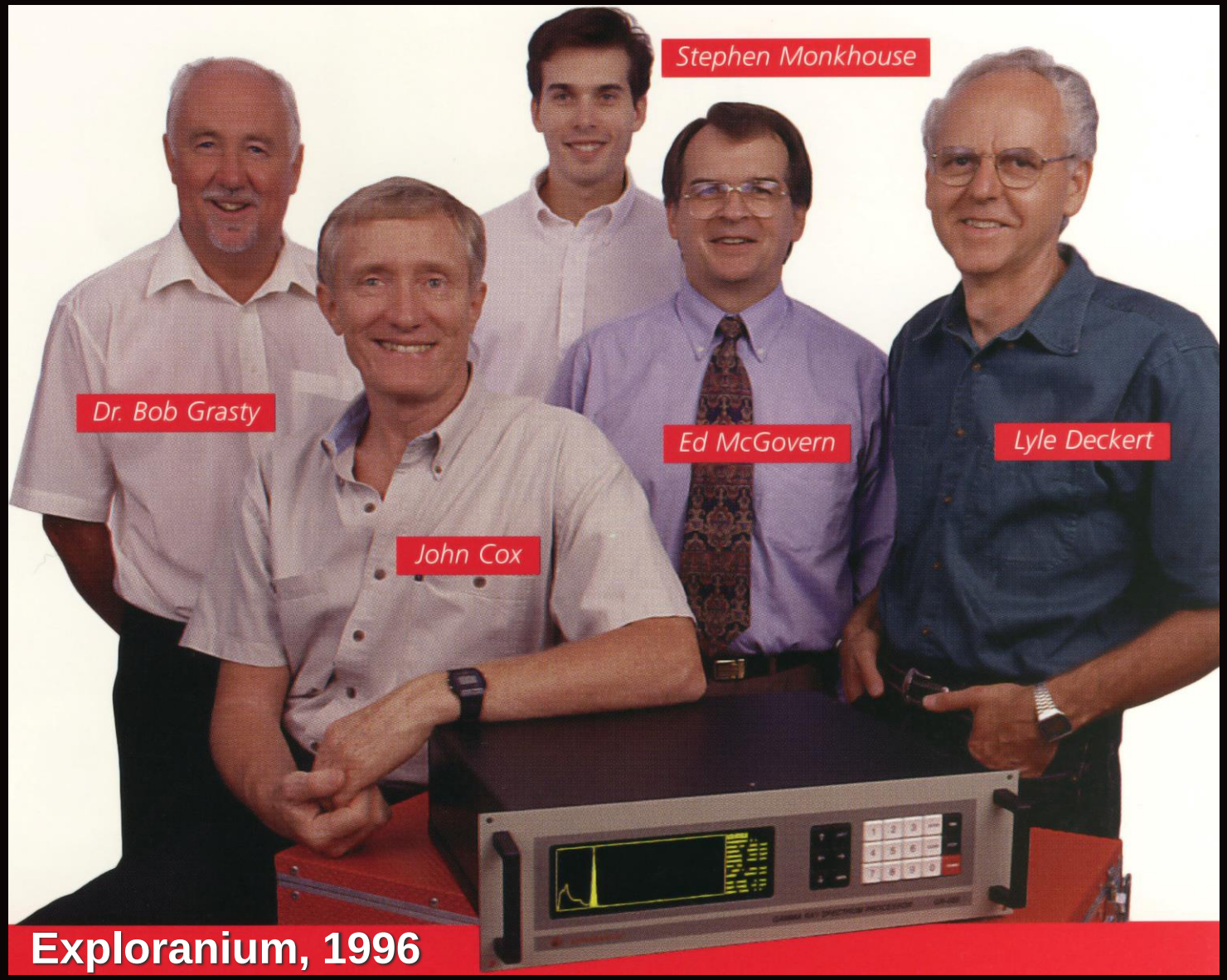
Terraquest 1st Horizontal Gradiometer, 1990

Geotech Hummingbird 2 Freq. System, 1990


SPECTREM, 1991

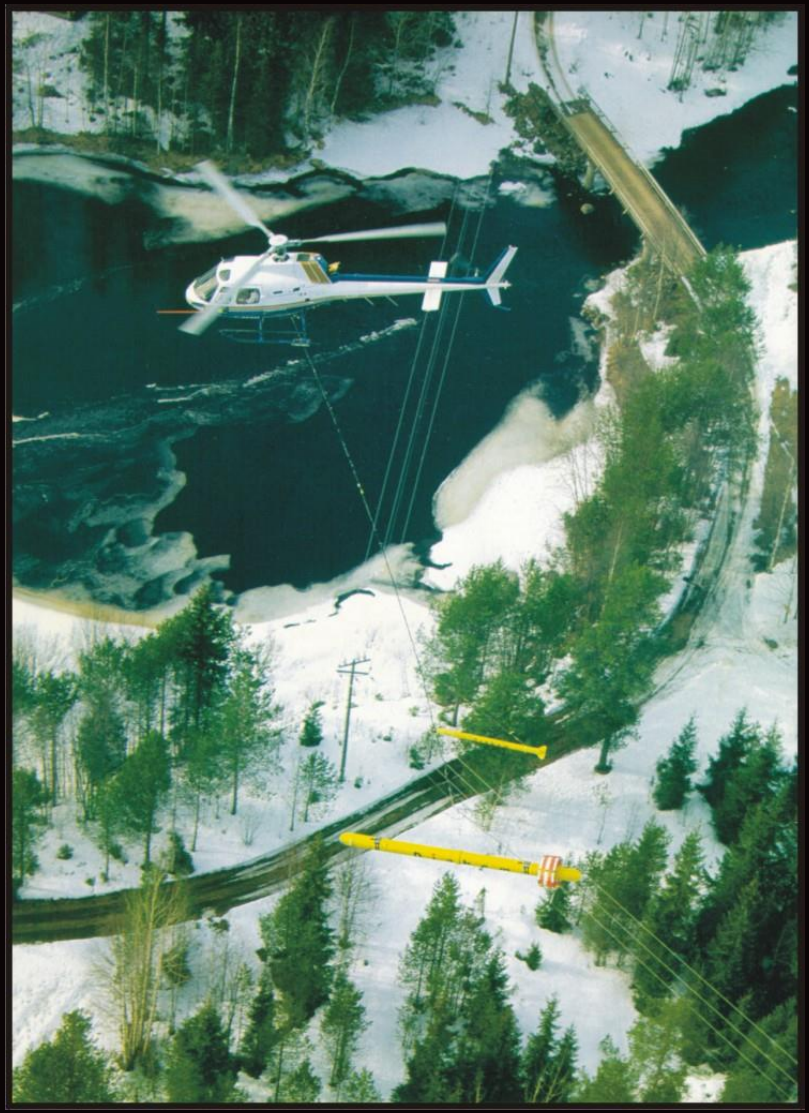

SPECTREM, 1991
ZS-ASN


GTK Twin Otter, 1995



Exploranium, 1996

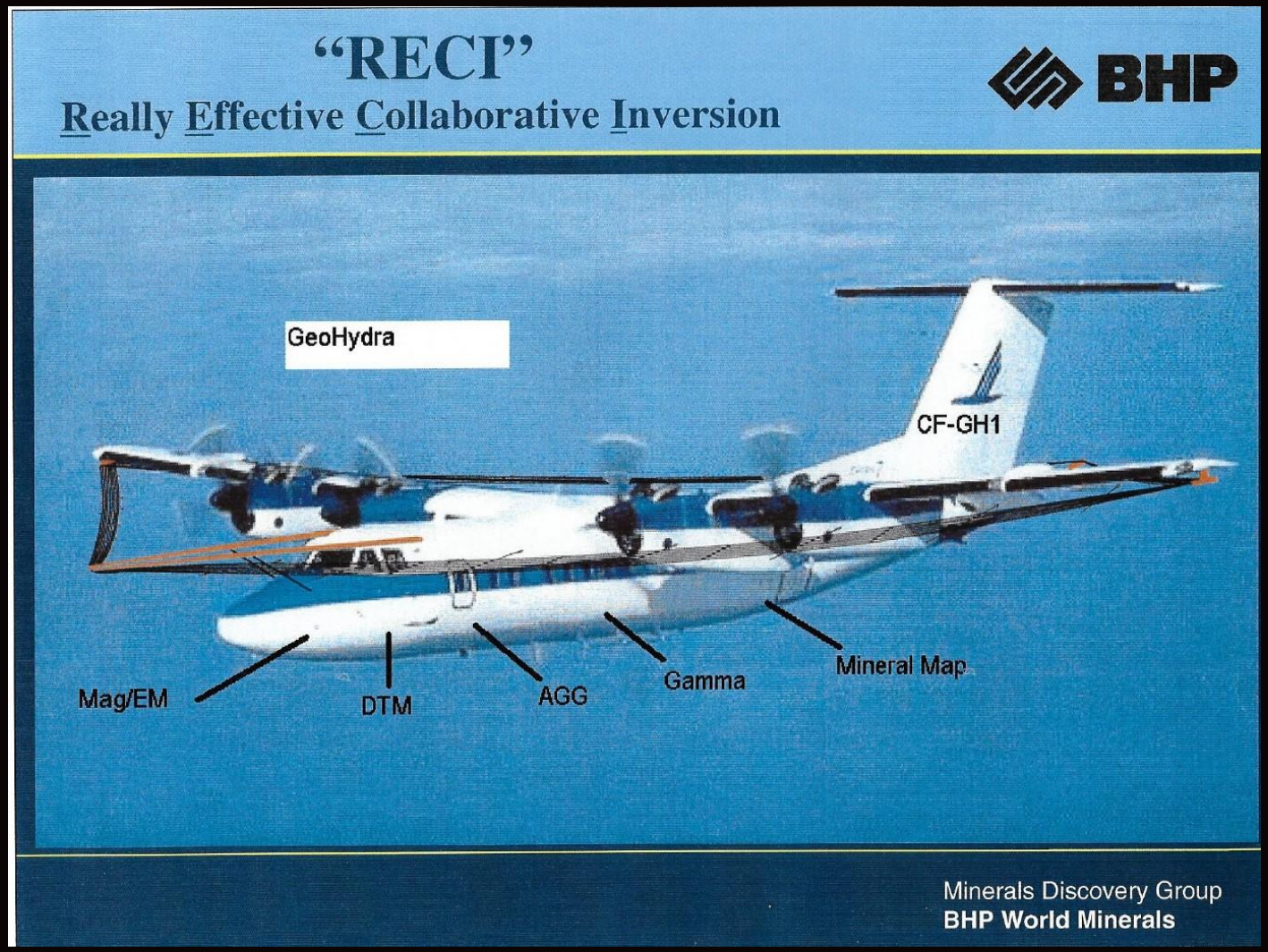
Aerodat HELITEM System, 1996



Dighem operating in Scandinavia-1995

Dighem doing fly-by of CN Tower-1995

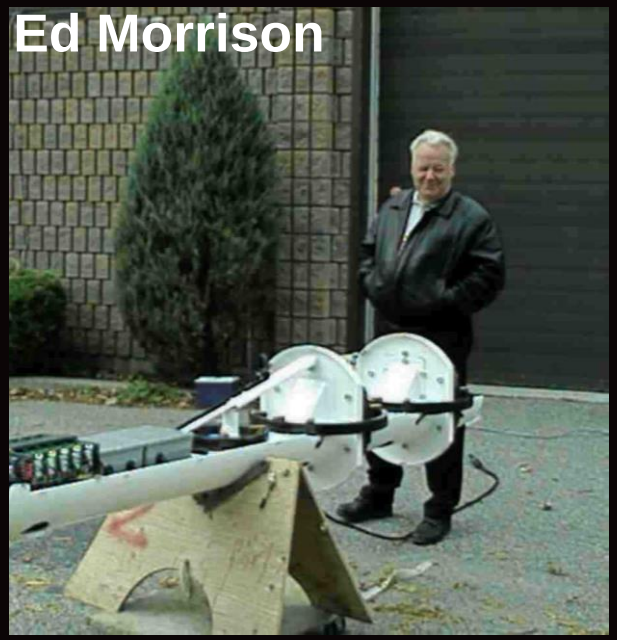

MEGATEM, Chile
1998



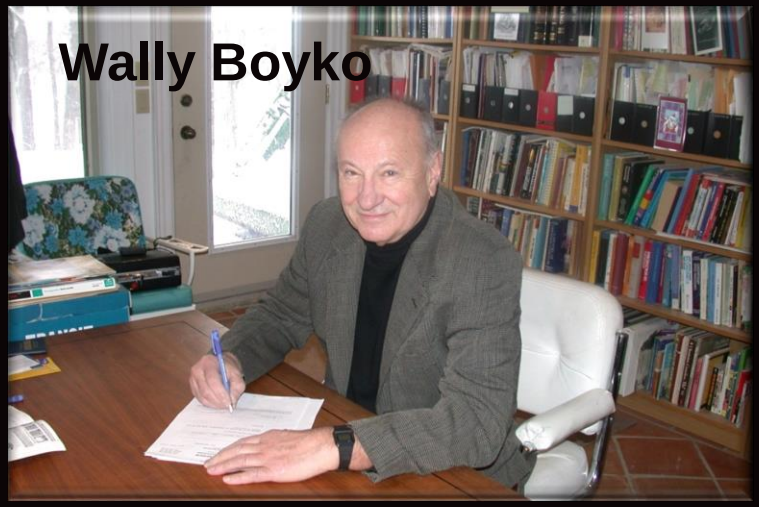
Concept Platform 1998

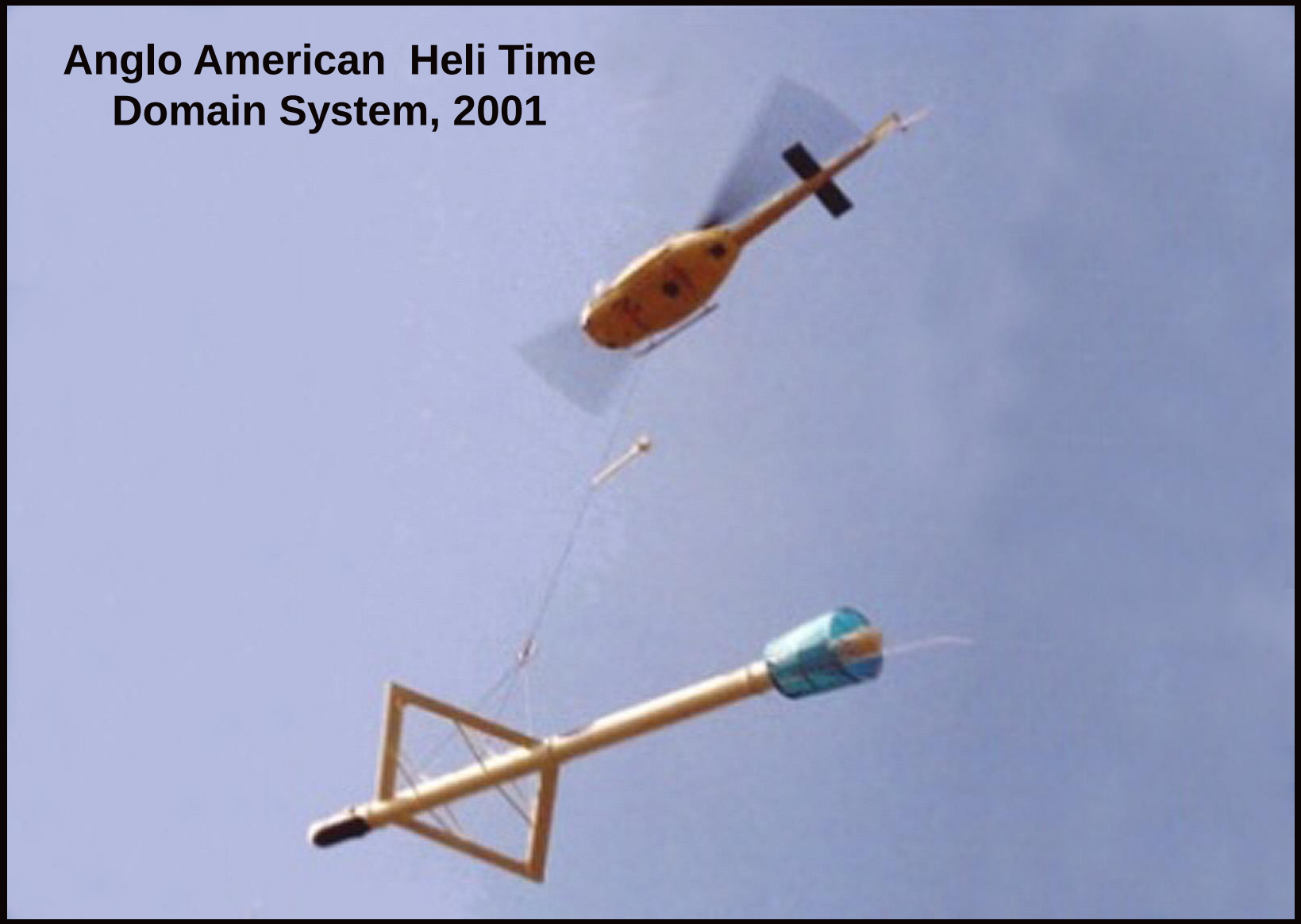
Geotech Hummingbird, 1998

Geotech Hawk, 1999
Roger Henderson



Major HeliTEM developers late 1990s-early 2000s




Anglo American Heli Time
Domain System, 2001

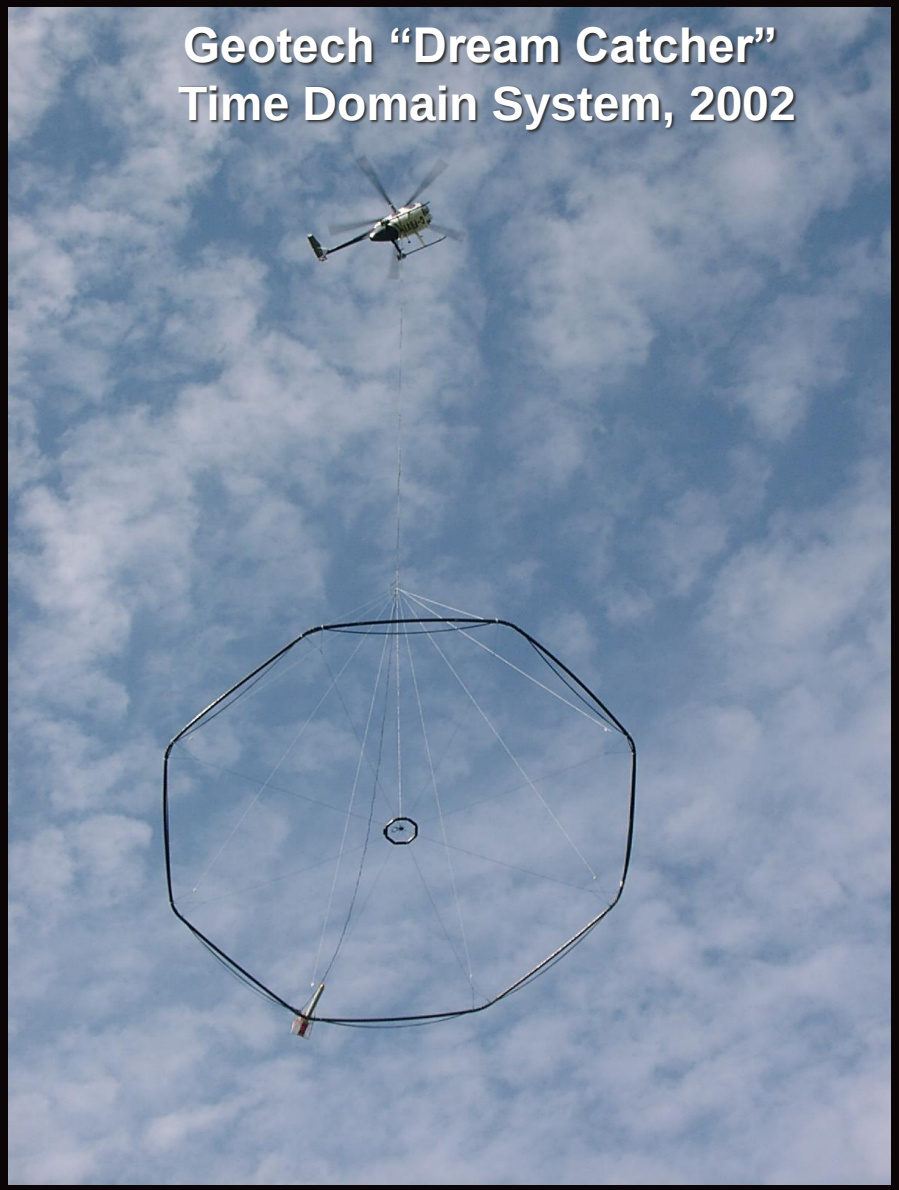
THEM loop, early 2000s

Bernie Kremer

THEM in-flight, early 2000s

MEGATEM II System, 2001

Geotech AFMAG (later called ZTEM), 2001


Geotech “Dream Catcher”
Time Domain System, 2002

Aeroquest AEROTEM 2003

Aeroquest IMPULSE, 2003

HoisTEM-2003

Geotech VTEM II, 2004

Excalibre Horizontal Gradiometer, 2005

SkyTEM-2003

SkyTEM System

- time range: 20 µs - 10 ms
- Tx-size: 10 x10 meter, max current 50 amps, square wave
- adapted Tx pattern, highest Tx-moment: 20.000 ampxm2
- adapted Rx receiver system providing no bias or leveling corrections.
- Tx-Rx altitude: 10 - 30 meter
- total weight: 280 kg (all included)
- operates "stand-alone", no operator or equipment in helicopter
- fast on-site mobilization


Fugro HELIGEOTEM, 2006