Natural Resources Canada / Ressources naturelles Canada

MARINE MINERALS TECHNOLOGY CENTER
OCEAN BASINS DIVISION

BASE LEGEND

- Cenozoic
- Mesozoic
- Paleozoic
- Proterozoic
- Archean and undivided Precambrian

MESOZOIC OR YOUNGER FAULTS
- Unclassified
- Normal
- Thrust, nappe
- Strike-slip
- Plate boundary

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The compilation of active and recently active volcanoes in the shallow submarine environment (1971-1993) was provided by T. Simkin and L. Siebert of the Global Volcanism Program, Smithsonian Institution.

Topography used for shaded relief was provided in digital format by W.A. Rowe and W. Miller, Geophysics Division, and D. Oakey, Atlantic Geoscience Centre, Geological Survey of Canada. Land topography was digitized from Physiographic Shaded Relief, Geological Survey of Canada, Open File 2800, January, 1994, combined with ETOPO5: Relief Map of the Earth's Surface, EOS Transactions, American Geophysical Union, Volume 67, p. 721, 1986

Oceanic plate boundaries were provided in digital format by W.R. Roest, Geophysics Division, Geological Survey of Canada, from Sclater, J.G., Hellinger, S., University of Sydney, Australia, and were derived from: Mueller, R.D., Roest, W.R., Royer, J.-C., Gahagan, L., and Sclater, J.G., A Digital Age Map of the Ocean Floor, Scripps Institute of Oceanography Reference Series no. 93-30, 1993

Land-based geology was derived from Kirkham, R.V., Chorlton, L.B., and Carrière, J.J., Generalized Geology of the World, Geological Survey of Canada, Open File 2915a, August 1994

Coastlines and drainage were obtained from ArcWorld, 1:25 000 000 scale, and are copyrighted data containing the intellectual property of Environmental Systems Research Institute (ESRI)

Examples of shallow submarine hot springs and related mineral deposits.

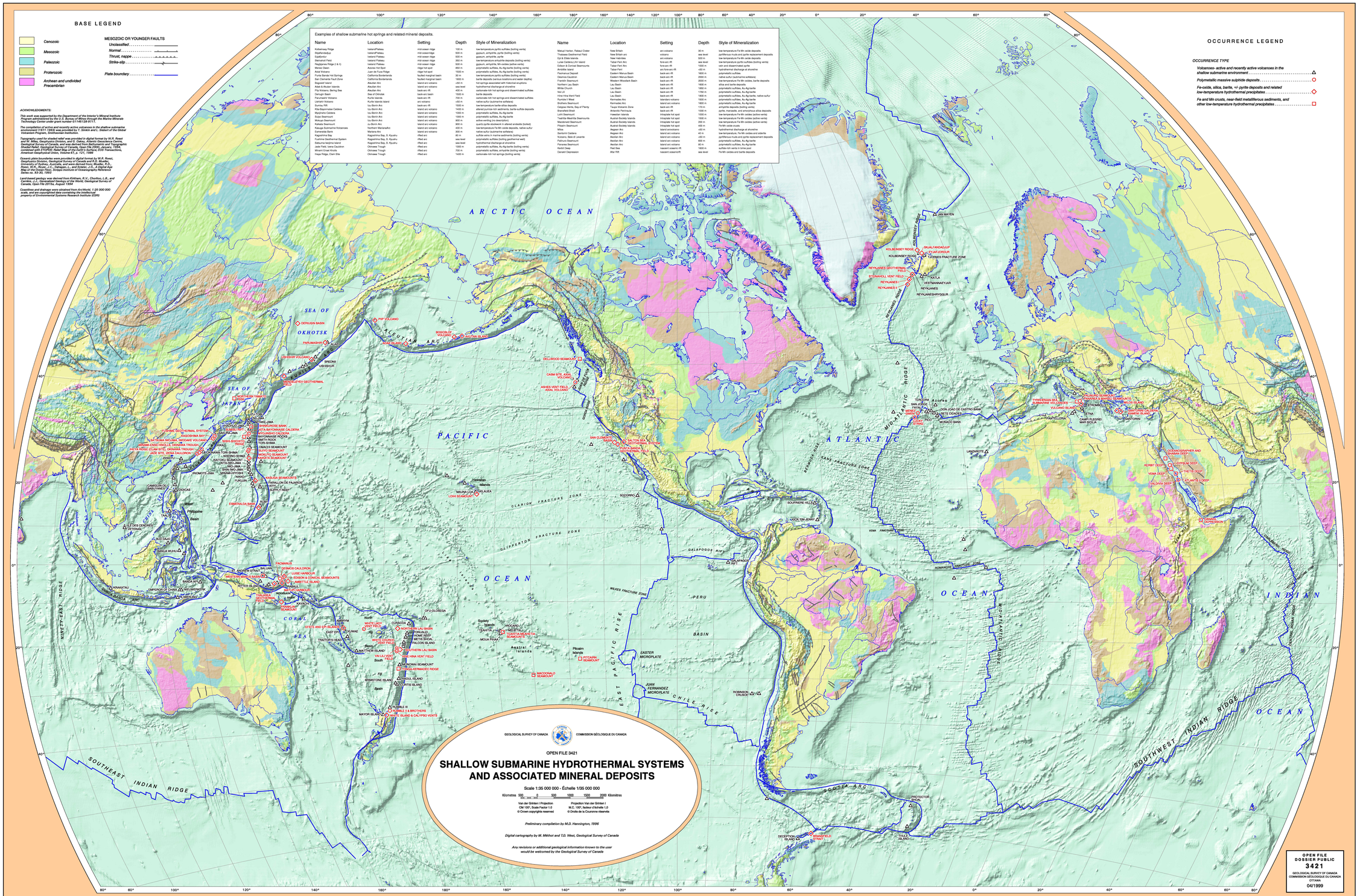
Name	Location	Setting	Depth	Style of Mineralization
Kolbeinsey Ridge	Iceland Plateau	mid-ocean ridge	100 m	low-temperature pyrite-sulfides (boiling vents)
Skjaldarbudjup	Iceland Plateau	mid-ocean ridge	500 m	gypsum, anhydrite, pyrite (boiling vents)
Eyjafjördur	Iceland Plateau	mid-ocean ridge	500 m	gypsum, anhydrite, pyrite
Grimsey Field	Iceland Plateau	mid-ocean ridge	500 m	low-temperature pyrite-sulfide deposits (boiling vents)
Reykjanes Ridge (1 & 3)	Iceland Plateau	mid-ocean ridge	500 m	gypsum, anhydrite, Mn-oxides (active vents)
Menez Gwen	Azores Hot Spot	ridge hot spot	850 m	polymetallic sulfides, Au-Ag-barite (boiling vents)
Axial Volcano	Juan de Fuca Ridge	ridge hot spot	1500 m	polymetallic sulfides, Au-Ag-barite (boiling vents)
Furnia Sandia Hot Springs	California Borderlands	faulted marginal basin	30 m	low-temperature pyrite-sulfides (boiling vents)
San Clemente Fault Zone	California Borderlands	faulted marginal basin	1800 m	barite deposits (various locations and water depths)
Sagoseki Island	Aleutian Arc	island arc volcano	<50 m	hot springs associated with historical eruptions
Adak & Akutan Islands	Aleutian Arc	island arc volcano	sea level	hydrothermal discharge at shoreline
Pip Volcano, Bering Sea	Aleutian Arc	back-arc rift	400 m	carbonate-rich hot springs and disseminated sulfides
Piip Seamount	Aleutian Arc	back-arc basin	1700 m	barite deposits
Tarumaiyama Volcano	Kurile Islands	back-arc rift	700 m	carbonate-rich hot springs and disseminated sulfides
Usishiri Volcano	Kurile Islands Island	arc volcano	<50 m	native sulfur (submarine solfatara)
Suntsu Rift	Izu-Bonin Arc	back-arc rift	1500 m	low-temperature barite-silica deposits
Kita-Bayonnaise Caldera	Izu-Bonin Arc	island arc volcano	1400 m	altered pumice-rich sediments, barite-sulfide deposits
Myojinsho Caldera	Izu-Bonin Arc	island arc volcano	1000 m	polymetallic sulfides, Au-Ag-barite
Suyo Seamount	Izu-Bonin Arc	island arc volcano	1300 m	polymetallic sulfides, Au-Ag-barite
Minami Seamount	Izu-Bonin Arc	island arc volcano	900 m	active venting (no description)
Kaikata Seamount	Izu-Bonin Arc	island arc volcano	900 m	quartz-pyrite stockwork in altered andesite (boiled)
Nishinoshima Volcanoes	Ogasawara (Bonin) Arc	island arc volcano	100 m	low-temperature Fe-Mn-oxides (active vents), native sulfur
Kaminaka Bank	Nankai Arc	island arc volcano	300 m	native sulfur (submarine solfatara)
Kagoshima Bay	Kagoshima Bay, S. Kyushu	rifted arc	80 m	sulfide veins in marine sediments (boiling vents)
Fukiehama Geothermal System	Kagoshima Bay, S. Kyushu	rifted arc	sea level	polymetallic sulfides (boiling geothermal well)
Sakurajima Volcano	Kagoshima Bay, S. Kyushu	rifted arc	sea level	hydrothermal discharge at shoreline
Jade Field, Izena Cauldron	Okinawa Trough	rifted arc	1300 m	polymetallic sulfides, Au-Ag-barite (boiling vents)
Minami Ensei Knolls	Okinawa Trough	rifted arc	700 m	polymetallic sulfides, anhydrite (boiling vents)
Iheya Ridge, Chain Site	Okinawa Trough	rifted arc	1400 m	carbonate-rich hot springs (boiling vents)

Name	Location	Setting	Depth	Style of Mineralization
Matuzi Harbor, Rabaul Crater	New Britain	arc volcano	30 m	low-temperature Fe-Mn-oxide deposits
Tholasea Geothermal Field	New Britain arc	volcano	sea level	pyrite/trace inuits and pyrite-replacement deposits
Epi & Efate Islands	New Hebrides	arc volcano	500 m	low-temperature Fe-Mn-oxide deposits
Lutao Cedera (Jhi) Island	Taiwan Fent Arc	fore-arc rift	sea level	low-temperature pyrite-sulfides (boiling vents)
Edison & Conical Seamounts	Taiwan Fent Arc	fore-arc rift	1000 m	vein and disseminated pyrite
Aoshima Island	Taiwan Fent	arc fore-arc rift	<50 m	hydrothermal discharge at shoreline
Pershanca Deposit	Eastern Manus Basin	back-arc rift	1600 m	polymetallic sulfides
Desmos Caldera	Eastern Manus Basin	back-arc rift	1000 m	native sulfur (submarine solfatara)
Franklin Seamount	Western Woodlark Basin	back-arc rift	2000 m	low-temperature Fe-Mn-oxides, barite deposits
Northern Lau Basin	Lau Basin	back-arc rift	1800 m	silica and barite deposits
White Church	Lau Basin	back-arc rift	1850 m	polymetallic sulfides, Au-Ag-barite
Vai L10	Lau Basin	back-arc rift	1750 m	polymetallic sulfides, Au-Ag-barite
Hine Hina Vent Field	Lau Basin	back-arc rift	1850 m	polymetallic sulfides, Au-Ag-barite, native sulfur
Pumice 1 West	Kermadec Arc	Islanders volcano	1500 m	polymetallic sulfides, Au-Ag-barite
Brothers Seamount	Kermadec Arc	island arc volcano	1850 m	polymetallic sulfides, Au-Ag-barite
Calypso Vents, Bay of Plenty	Taupo Volcanic Zone	back-arc rift	170 m	anhydrite deposits (boiling vents)
Rumble II West	Kermadec Arc	back-arc rift	1100 m	low-temperature Fe-Mn-oxides, barite silica deposits
Lohi Seamount	Hikurangi Margin	intraplate hot spot	1000 m	low-temperature Fe-Mn-oxides (active vents)
Teahitia-Mareihe Seamounts	Austral-Society Islands	intraplate hot spot	1500 m	low-temperature Fe-Mn-oxides (active vents)
Macdonald Seamount	Austral-Society Islands	intraplate hot spot	200 m	low-temperature Fe-Mn-oxides (active vents)
Pitcairn Seamount	Austral-Society Islands	intraplate hot spot	400 m	Fe-Mn oxide crusts
Milos	Aegean Arc	island arc volcano	<20 m	hydrothermal discharge at shoreline
Santorini Caldera	Aegean Arc	island arc volcano	40 m	low-temperature, Fe-Mn oxides and siderite
Vulcano, Baia di Levante	Aeolian Arc	island arc volcano	<50 m	pyrite/trace inuits and pyrite-replacement deposits
Pathiums Seamount	Aeolian Arc	island arc volcano	600 m	polymetallic sulfides, Au-Ag-barite
Marsili Seamount	Aeolian Arc	back-arc basin	3500 m	native sulfur, Fe-Mn-oxides (active vents)
Kerinitis Deep	Red Sea	nascent oceanic rift	1800 m	sulfide-rich vents in brine pool
Danakil Depression	Afar Rift	nascent oceanic rift	sea level	Fe-Mn oxides and barite deposits

OCCURRENCE LEGEND

OCCURRENCE TYPE

- *Volcanoes- active and recently active volcanoes in the shallow submarine environment*
- *Polymetallic massive sulphide deposits*
- *Fe-oxide, silica, barite, +/- pyrite deposits and related low-temperature hydrothermal precipitates*
- *Fe and Mn crusts, near-field metalliferous sediments, and other low-temperature hydrothermal precipitates*



GEOLOGICAL SURVEY OF CANADA — COMMISSION GÉOLOGIQUE DU CANADA

OPEN FILE 3421

SHALLOW SUBMARINE HYDROTHERMAL SYSTEMS AND ASSOCIATED MINERAL DEPOSITS

Scale 1:35 000 000 - Échelle 1/35 000 000

Kilometres 500 0 500 1000 1500 2000 Kilomètres

Van der Grinten I Projection
CM 150°, Scale Factor 1.0
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Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

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