U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Isle Royale National Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Isle Royale National Park

isro_geology.pdf

Version: 3/31/2021

Geologic Resources Inventory Map Document for Isle Royale National Park

Table of Contents

Geologic Resources Inventory Map Document 1
About the NPS Geologic Resources Inventory Program 3
GRI Digital Map and Source Map Citations 5
Index Map 6
Map Unit List 7
Map Unit Descriptions 8
Qal - Alluvium (Holocene) 8
Qts - Talus, slopewash, and glacial drift (Holocene and Pleistocene) 8
Qg - Glacial till (Pleistocene) 8
Copper Harbor Conglomerate 8
cu - Copper Harbor Conglomerate, undetermined 8
cc - Copper Harbor Conglomerate, chiefly conglomerate (Middle Keweenawan) 8
cb - Copper Harbor Conglomerate, boulder and cobble conglomerate (Middle Keweenawan) 9
cp - Copper Harbor Conglomerate, pebble conglomerate (Middle Keweenawan) 9
cs - Copper Harbor Conglomerate, chiefly sandstone (Middle Keweenawan) 9
Portage Lake Volcanics 9
pu - Portage Lake Volcanics, lava flows, undivided (Middle Keweenawan) 10
psc - Portage Lake Volcanics, sandstone and conglomerate (Middle Keweenawan) 10
pp - Portage Lake Volcanics, pyroclastic rocks (Middle Keweenawan) 10
psp - Portage Lake Volcanics, Scoville Point Flow (Middle Keweenawan) 10
pei - Portage Lake Volcanics, Edwards Island Flow (Middle Keweenawan) 10
pmp - Portage Lake Volcanics, Middle Point Flow (Middle Keweenawan) 10
pli - Portage Lake Volcanics, Long Island Flow (Middle Keweenawan) 10
pth - Portage Lake Volcanics, Tobin Harbor Flow (Middle Keweenawan) 10
pwi - Portage Lake Volcanics, Washington Island Flow (Middle Keweenawan) 11
pg - Portage Lake Volcanics, Greenstone Flow (Middle Keweenawan) 11
pgi - Portage Lake Volcanics, Grace Island Flow (Middle Keweenawan) 11
pm - Portage Lake Volcanics, Minong Flow (Middle Keweenawan) 11
ph - Portage Lake Volcanics, Huginnin Flow (Middle Keweenawan) 11
php - Portage Lake Volcanics, Hill Point Flow (Middle Keweenawan) 11
pai - Portage Lake Volcanics, Amygdaloid Island Flow (Middle Keweenawan) 11
Geologic Cross Sections 12
Geologic Cross Section A-A' 12
Geologic Cross Section B-B' 12
Ancillary Source Map Information 13
Isle Royale National Park 13
Explanation 13
Map Legend 15
Distribution of Keweenawan Rocks in the Lake Superior Region 16
Geologic Summary - Isle Royale National Park 17
Selected References 19
Copper Harbor Conglomerate on Isle Royale 20
Map Explanation 20
Area of Report 21

Document (Report Booklet)..... 22
GRI Digital Data Credits..... 23

Geologic Resources Inventory Map Document

Isle Royale National Park, Michigan

Document to Accompany Digital Geologic-GIS Data

isro_geology.pdf

Version: 3/31/2021

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Isle Royale National Park, Michigan (ISRO).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Map and Source Citations** – A listing of the GRI digital geologic-GIS map produced for this project along with sources used in its completion. In addition, a brief explanation of how each source map was used is provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units.

5) **Geologic Cross Sections** – Geologic cross section graphics.

6) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.

7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
Fort Collins, CO 80523
phone: (970) 491-6655
e-mail: stephanie_o'meara@partner.nps.gov

About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: https://www.nps.gov/articles/gri-geodatabase-model.htm

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: https://go.nps.gov/gripubs. GRI digital geologic-GIS data is also available online at the NPS Data Store: https://irma.nps.gov/DataStore/Search/Quick. To find GRI data for a specific park or parks select the appropriate park(s), enter “GRI” as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: https://

www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a “Contact Us” link if you need additional information. You may also directly contact the program coordinator:

Jason Kenworthy
Inventory Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 987-6923
fax: (303) 987-6792
email: Jason_Kenworthy@nps.gov

The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: https://www.nps.gov/im/inventories.htm.

GRI Digital Map and Source Map Citations

The GRI digital geologic-GIS map for Isle Royale National Park, Michigan (ISRO) is listed below.

Digital Geologic-GIS Map of Isle Royale National Park and Vicinity, Michigan (*GRI MapCode ISRO*)

The map was produced from the following source maps.

Huber, N. King , 1973, Geologic Map of Isle Royale National Park, Keweenaw County, Michigan: U.S. Geological Survey, Miscellaneous Geologic Investigations Map I-796, scale 1:62,500 (Isle Royale National Park). (*GRI Source Map ID 2663*).

Wolff, R.G., and Huber, N.K., 1973, The Copper Harbor Conglomerate (middle Keweenawan) on Isle Royale, Michigan, and its Regional Implications: U.S. Geological Survey, Professional Paper 754-B, scale 1:62,500 (Copper Harbor Conglomerate on Isle Royale). (*GRI Source Map ID 4951*).

U.S. Geological Survey, 1996, USGS Digital Raster Graphics (Isle Royale Area): U.S. Geological Survey, 7.5' Topographic Quadrangle, scale 1:24,000. (*GRI Source Map ID 4949*).

Geologic features were captured from the Huber, 1973 map, as well as from the Wolff and Huber, 1973 publication. The full extent of both maps was used, however, only a limited number of features, those pertaining to the Copper Harbor Conglomerate unit, and a cross section line, were captured from the Wolff and Huber, 1973 publication. The USGS Digital Raster Graphics (1996) was used to capture more recent and more detailed water and shoreline contacts.

Additional information pertaining to each source map is also presented in the GRI Source Map Information (ISROMAP) table included with the GRI geologic-GIS data.

Index Map

The following index map displays the extent of Isle Royale Island and the GRI digital geologic-GIS map produced for Isle Royale National Park (ISRO). The boundary for Isle Royale National Park (as of April, 2021) is outlined in green. The extent of the source map Professional Paper 754-B is presented in gray. Member units of the Copper Harbor Conglomerate, present with this extent, were interpreted using this source map.



Index map by Stephanie O'Meara (Colorado State University).

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Isle Royale National Park, Michigan (ISRO) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qal - Alluvium). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (ISROUNIT) table included with the GRI geologic-GIS data.

Cenozoic Era

Quaternary Period

Qal - Alluvium
Qts - Talus, slopewash, and glacial drift
Qg - Glacial till

Precambrian Eon

Middle Keweenawan Time

Copper Harbor Conglomerate
- cu - Copper Harbor Conglomerate, undetermined
- cc - Copper Harbor Conglomerate, chiefly conglomerate
- cb - Copper Harbor Conglomerate, boulder and cobble conglomerate
- cp - Copper Harbor Conglomerate, pebble conglomerate
- cs - Copper Harbor Conglomerate, chiefly sandstone

Portage Lake Volcanics
- pu - Portage Lake Volcanics, lava flows, undivided
- psc - Portage Lake Volcanics, sandstone and conglomerate
- pp - Portage Lake Volcanics, pyroclastic rocks
- psp - Portage Lake Volcanics, Scoville Point Flow
- pei - Portage Lake Volcanics, Edwards Island Flow
- pmp - Portage Lake Volcanics, Middle Point Flow
- pli - Portage Lake Volcanics, Long Island Flow
- pth - Portage Lake Volcanics, Tobin Harbor Flow
- pwi - Portage Lake Volcanics, Washington Island Flow
- pg - Portage Lake Volcanics, Greenstone Flow
- pgi - Portage Lake Volcanics, Grace Island Flow
- pm - Portage Lake Volcanics, Minong Flow
- ph - Portage Lake Volcanics, Huginnin Flow
- php - Portage Lake Volcanics, Hill Point Flow
- pai - Portage Lake Volcanics, Amygdaloid Island Flow

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Qal - Alluvium (Holocene)

Chiefly lake and stream deposits; locally includes both modern and elevated beach deposits. Most of the area so mapped is occupied by swamps, bogs, and beaver ponds. Description from source map: Isle Royale National Park

Qts - Talus, slopewash, and glacial drift (Holocene and Pleistocene)

Qts Talus, slopewash, and glacial drift (Pleistocene and Holocene)
Varied surficial materials including large amounts of more or less reworked glacially transported debris; locally includes elevated beach deposits. Mapped only on western third of island, where extensive deposits effectively conceal bedrock over large areas. On northwestern end of island, north of Washington Creek, overlay pattern on bedrock units indicates extensive but less continuous surficial cover. Description from source map: Isle Royale National Park

Qg - Glacial till (Pleistocene)

Glacial till in ice-margin deposits formed during pauses in the retreat of the last (Valderan) ice sheet in the Lake Superior basin. Description from source map: Isle Royale National Park

Copper Harbor Conglomerate

Conglomerate and sandstone, chiefly composed of detritus from both felsic and mafic volcanic rocks. Description from source map: Isle Royale National Park

The unit is mapped as 'member' units, cc, cb, cp and cs between the two source geologic maps.

cu - Copper Harbor Conglomerate, undetermined

Several islands on the Huber, 1973 map were inferred to be Copper Harbor Conglomerate, but the unit undeterminable. These areas are attributed as 'cu' in the GRI digital geologic-GIS data.

cc - Copper Harbor Conglomerate, chiefly conglomerate (Middle Keweenawan)

Chiefly conglomerate unit of the Copper Harbor Conglomerate. Description from source map: Isle Royale National Park

Unit is mapped in the GRi digital geologic-GIS dat as unit 'cb' using source map U.S. Geological Survey, Professional Paper 754-B (Copper Harbor Conglomerate on Isle Royale).

cb - Copper Harbor Conglomerate, boulder and cobble conglomerate (Middle Keweenawan)

Massive reddish conglomerate containing discontinuous beds and lenses of pebble conglomerate and coarse-grained sandstone. Description from source map: Copper Harbor Conglomerate on Isle Royale

cp - Copper Harbor Conglomerate, pebble conglomerate (Middle Keweenawan)

Thin- to massive-bedded arkosic conglomerate (average pebble size less than 1 inch) with many sandstone interbeds. Description from source map: Copper Harbor Conglomerate on Isle Royale

cs - Copper Harbor Conglomerate, chiefly sandstone (Middle Keweenawan)

Chiefly sandstone unit of the Copper Harbor Conglomerate. Description from source map: Isle Royale National Park

Portage Lake Volcanics

Sequence of basalt and andesite lava flows with interbedded sedimentary and pyroclastic flows.

pu	lava flows, undivided
psc	sandstone and conglomerate
pp	pyroclastic rocks

Certain stratigraphic units representing individual lava flows or groups of flows can be identified and traced on the basis of characteristic textures or structures and relative stratigraphic position. Twelve such units are distinguished on the map and have been named for ease of reference.

Rock names based on characteristic textures and used to describe individual flows are defined as follows: trap, fine-grained, dense rock commonly showing conchoidal feature and polygonal jointing; porphyrite, rock with plagioclase phenocrysts scattered through a finer-grained ground mass; ophite, rocks with crystals of pyroxene enclosing unoriented plagioclase laths, producing a mottled effect, accentuated by weathering)pyroxene crystals range from a few millimeters to more than 2 cm in different specimens); pegmatite, coarse-grained rock, typically with mat of prominent plagioclase laths.

Named flows within the Portage Lake Volcanics:

psp	Scoville Point Flow
pei	Edwards Island Flow
pmp	Middle Point Flow
pli	Long Island Flow
pth	Tobin Harbor Flow
pwi	Washington Island Flow
pg	Greenstone Flow
pgi	Grace Island Flow
pm	Minong Flow
ph	Huginnin Flow
php	Hill Point Flow
pai	Amygdaloid Island Flow

Description from source map: Isle Royale National Park

pu - Portage Lake Volcanics, lava flows, undivided (Middle Keweenawan)

Chiefly ophitic flood basalts. Locally includes some sedimentary rocks. Overlay pattern on northwestern end of island indicates extensive surficial cover by unit Qts. Not shown in box are individually named flows. Description from source map: Isle Royale National Park

psc - Portage Lake Volcanics, sandstone and conglomerate (Middle Keweenawan)

Chiefly composed of detritus from felsic and mafic volcanic rocks. Description from source map: Isle Royale National Park

pp - Portage Lake Volcanics, pyroclastic rocks (Middle Keweenawan)

Tuffs, breccias, and tuffaceous sedimentary rocks. Description from source map: Isle Royale National Park

psp - Portage Lake Volcanics, Scoville Point Flow (Middle Keweenawan)

Porphyrite characterized by mm-sized, blocky plagioclase phenocrysts uniformly distributed in finer-grained matrix. Description from source map: Isle Royale National Park

pei - Portage Lake Volcanics, Edwards Island Flow (Middle Keweenawan)

Trap characterized by polygonal joints, commonly with well-developed columnar structure. Description from source map: Isle Royale National Park

pmp - Portage Lake Volcanics, Middle Point Flow (Middle Keweenawan)

Porphyrite similar to Scoville Point Flow except phenocrysts less uniform in size and distribution. Description from source map: Isle Royale National Park

pli - Portage Lake Volcanics, Long Island Flow (Middle Keweenawan)

Trap characterized by polygonal joints, less commonly with well-developed columnar structure. Description from source map: Isle Royale National Park

pth - Portage Lake Volcanics, Tobin Harbor Flow (Middle Keweenawan)

Porphyrite similar to Middle Point Flow. Description from source map: Isle Royale National Park

pwi - Portage Lake Volcanics, Washington Island Flow (Middle Keweenawan)

Ophite characterized by abundant clots of dark-green chlorite and sparse plagioclase phenocrysts to up one cm in length; ophitic texture somewhat obscure. Description from source map: Isle Royale National Park

pg - Portage Lake Volcanics, Greenstone Flow (Middle Keweenawan)

Differentiated flow with basal part coarsely ophitic, central part pegmatitic, upper part medium to finely ophitic and pronounced columnar jointing at top of flow; mapped contact within flow is at base of pegmatitic zone, not seen west of Mount Desor. Description from source map: Isle Royale National Park

Unit is mapped as both an area feature, as well as a linear dike feature in the GRI digital geologic-GIS data.

pgi - Portage Lake Volcanics, Grace Island Flow (Middle Keweenawan)

Porphyrite characterized by lath-shaped plagioclase phenocrysts, commonly to 2 cm long, widely dispersed or as clots in a fine-grained matrix. Description from source map: Isle Royale National Park

pm - Portage Lake Volcanics, Minong Flow (Middle Keweenawan)

Trap containing scattered agates with characteristic whitish to light-bluish tint. Description from source map: Isle Royale National Park

ph - Portage Lake Volcanics, Huginnin Flow (Middle Keweenawan)

Porphyrite similar to Grace Island Flow. Description from source map: Isle Royale National Park

php - Portage Lake Volcanics, Hill Point Flow (Middle Keweenawan)

Ophite similar to basal coarsely ophitic part of Greenstone Flow. Description from source map: Isle Royale National Park

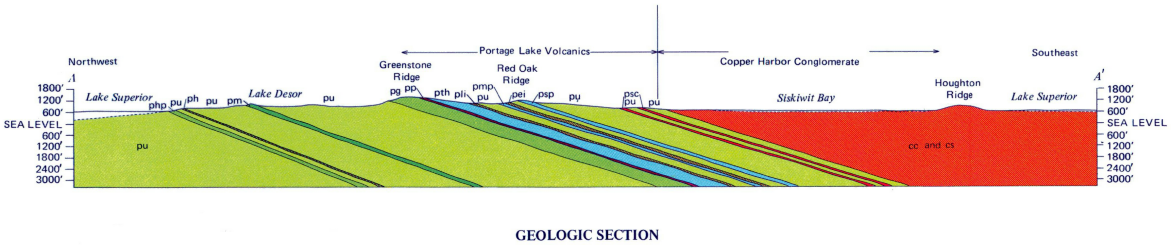
pai - Portage Lake Volcanics, Amygdaloid Island Flow (Middle Keweenawan)

Trap characterized by abundant agates that are typically reddish in tint and commonly contain coarsely crystalline quartz centers. Description from source map: Isle Royale National Park

Geologic Cross Sections

The geologic cross sections present in the GRI digital geologic-GIS data produced for Isle Royale National Park, Michigan (ISRO) are presented below. Note that one cross section abbreviations (e.g., A - A') was changed from its source map abbreviation in the GRI data so that each cross section abbreviation in the GRI data is unique. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (if viewing the digital format of this document). Both graphics are shown at a scale for presentation and do not accurately represent the actual length of each cross section line.

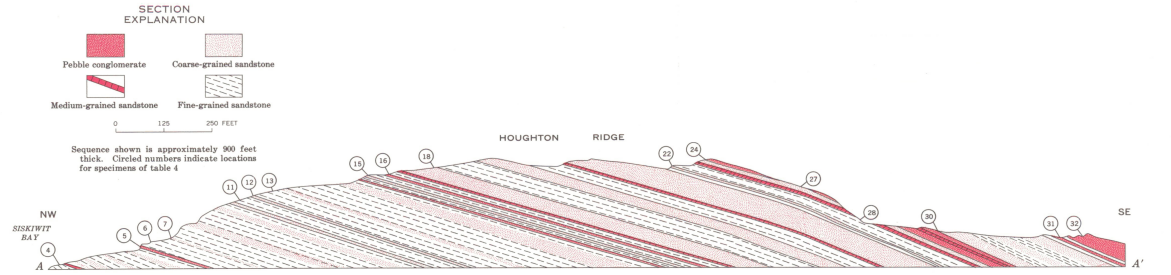
Geologic Cross Section A-A'



GEOLOGIC SECTION

Graphic from source map: Isle Royale National Park

Geologic Cross Section B-B'



Graphic from source map: Copper Harbor Conglomerate on Isle Royale. Cross section A-A' on source map.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project. No additional information is presented for the 1996 USGS Digital Raster Graphics (Isle Royale Area)

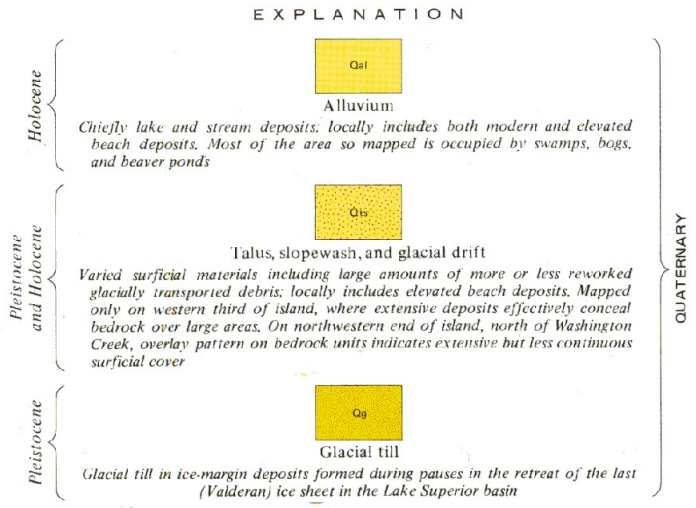
Isle Royale National Park

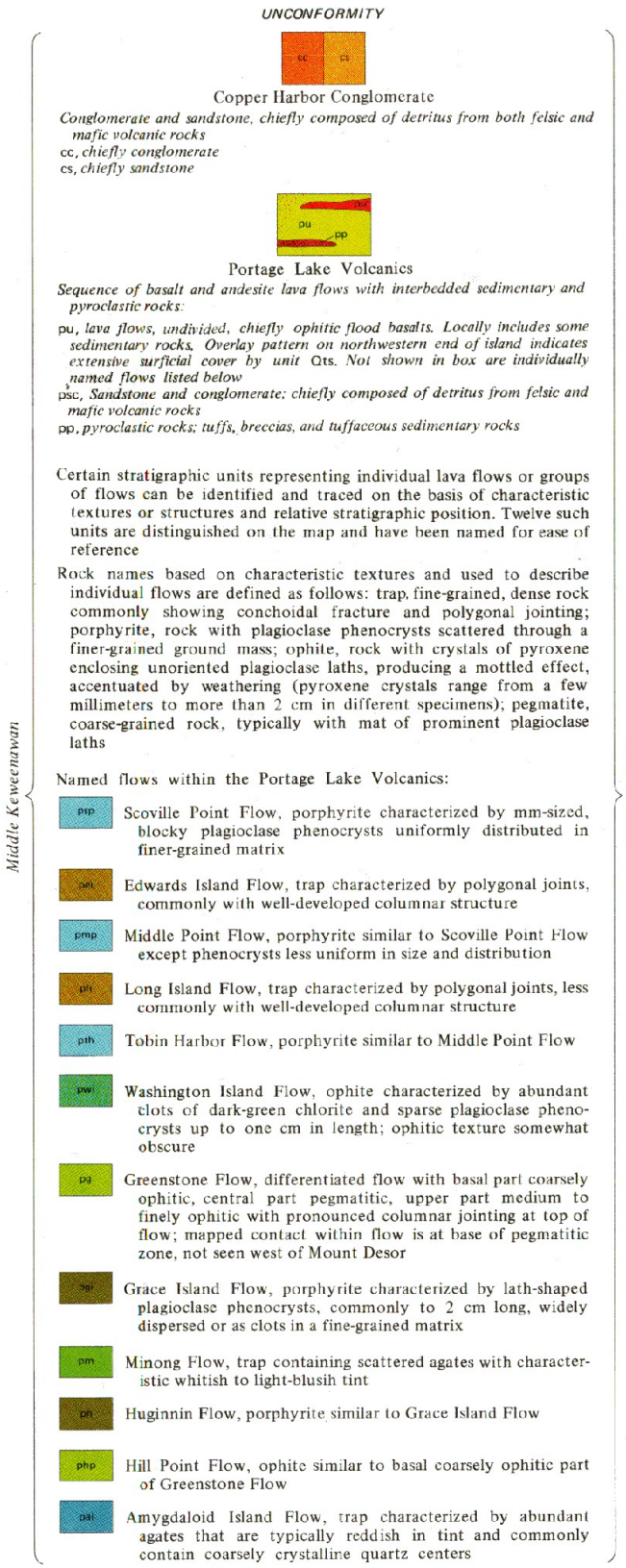
The formal citation for this source.

Huber, N. King , 1973, Geologic Map of Isle Royale National Park, Keweenaw County, Michigan: U.S. Geological Survey, Miscellaneous Geologic Investigations Map I-796, scale 1:62,500 (*GRI Source Map ID 2663*).

Prominent graphics and text associated with this source.

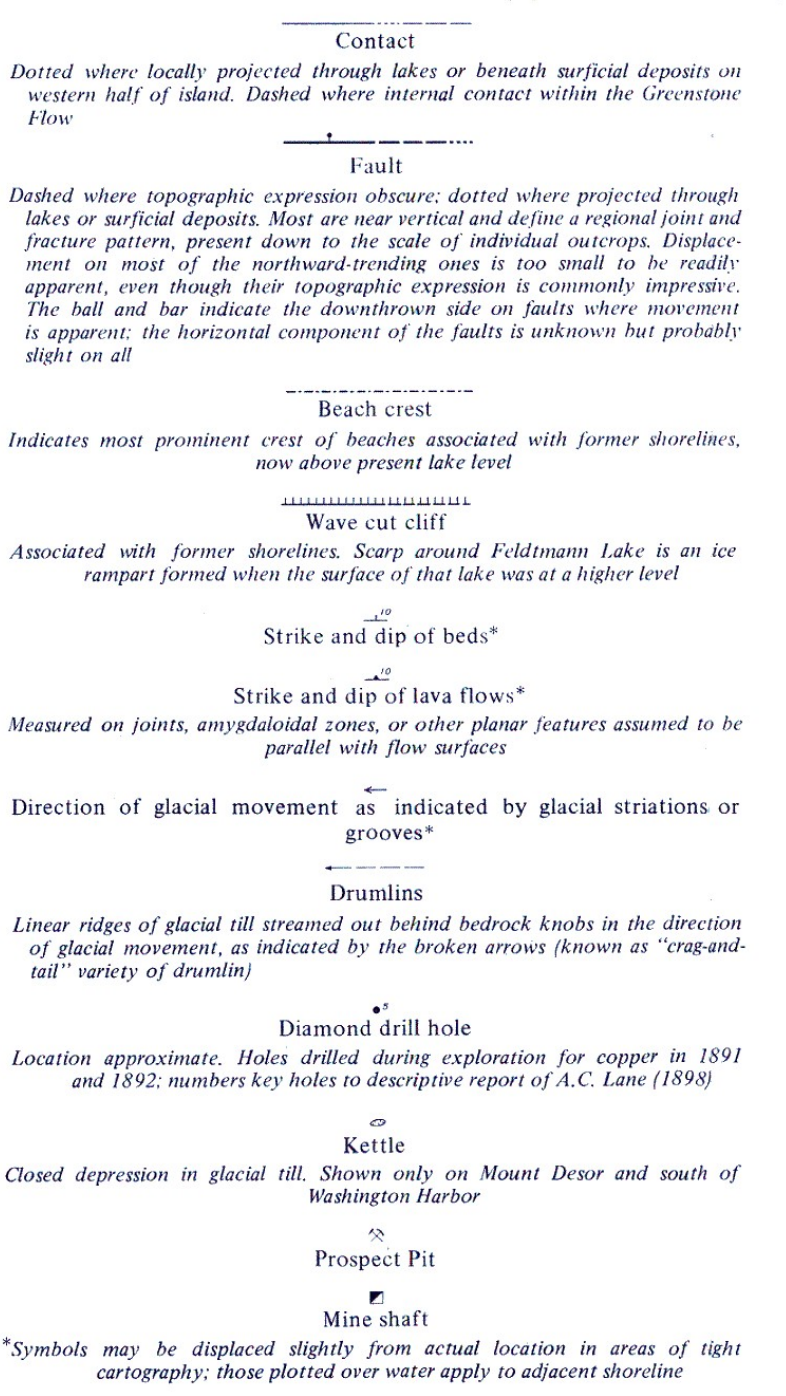
Explanation





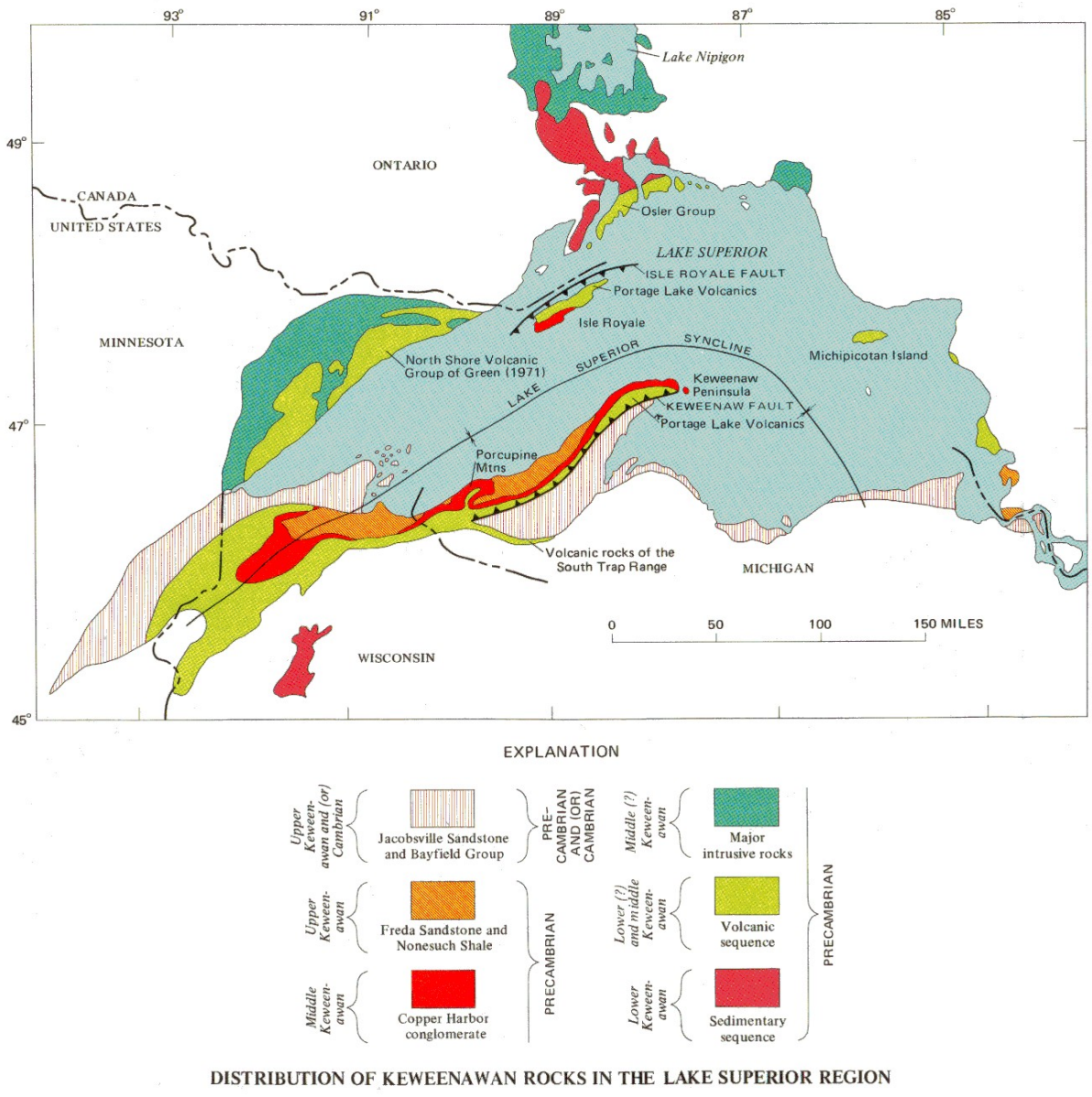
Graphic from source map: [Isle Royale National Park]

Map Legend



Graphic from source map: Isle Royale National Park

Distribution of Keweenawan Rocks in the Lake Superior Region



DISTRIBUTION OF KEWEENAWAN ROCKS IN THE LAKE SUPERIOR REGION

Graphic from source map: Isle Royale National Park

Geologic Summary - Isle Royale National Park

BEDROCK SEQUENCE

The bedrock sequence of Isle Royale consists of two formations, the Portage Lake Volcanics, and the overlying Copper Harbor Conglomerate, both of Precambrian (Middle Keweenawan) age.

Portage Lake Volcanics

The Portage Lake Volcanics is largely made up of basaltic and andesitic lava flows with interbedded sandstone, conglomerate, and pyroclastic rocks. Exposures on Isle Royale indicate a minimum thickness of 10,000 feet on the island, and as the base of the formation is not exposed, the total thickness may well be considerably greater. Within the sequence- which probably contains more than a hundred individual flows in the exposed section- certain stratigraphic units representing individual flows can be identified and traced on the basis of characteristic internal textures or structures and relative stratigraphic position. Twelve such flows have been distinguished within the sequence on Isle Royale (see map explanation); these key flows provide stratigraphic and structural control for the geologic map. Many of them can be traced the length of the island.

A number of thin sandstone and conglomerate units in the upper part of the section crop out with relatively good continuity between Siskiwit Lake and Moskey Basin in the east-central part of the island. These clastic rocks also are useful as key horizon markers, and although exposures are too poor to establish the fact, many of them probably extend the length of the island. Additional interbedded clastic rocks are known only from exploratory holes drilled during a search for copper on the western end of the island.

Copper Harbor Conglomerate

The Copper Harbor Conglomerate is a thick lithified wedge of gravel and sand spread out over the Portage Lake Volcanics as piedmont fan deposits and flood plain deposits. The clastic debris in the Copper Harbor Conglomerate was derived chiefly from older Keweenawan volcanic rocks and was transported generally eastward from a boulder conglomerate at Cumberland and Rainbow Points, through a mixture of cobble and pebble conglomerates and sandstone, to deposits on the islands in the eastern part of Siskiwit Bay that are chiefly sandstone and siltstone. Over this same distance of 20 miles, the formation thickens within marker horizons from 1,500 feet to more than 6,000 feet. Total thickness is unknown, as the top of the formation is concealed beneath Lake Superior.

BEDROCK STRUCTURE

The layered bedrock sequence on Isle Royale forms a homocline tilted toward the southeast. (See structure section.) Dips of the strata range from less than 10° to more than 50°; they are generally steeper on the north side of the island than on the south, and the dip averages less than 20°. The only major distortion superimposed upon the homoclinal structure on the island is within the Lake Richie-Chippewa Harbor area, where the upper part of the Portage Lake Volcanics is warped around a node of apparent uplift and fracturing. Also superimposed are joints and faults related to a regional fracture system. One set trends northward at the western end of the island, changing progressively eastward to trend about 30° E. of N. at McCargoe Cove. Minor vertical displacement is apparent along some of the faults in this set. Faults in a second set, trending east-west, commonly show somewhat greater displacement, but still no more than a few hundred feet at most.

REGIONAL SETTING AND PREGLACIAL GEOLOGIC HISTORY

Isle Royale lies on the north margin of the Lake Superior syncline, an arcuate structural basin that more or less follows the trend of present-day Lake Superior. (See inset map.) The Portage Lake Volcanics and Copper Harbor Conglomerate on Isle Royale extend beneath the lake and reappear on the Keweenaw Peninsula on the south shore. These formations overlie older Keweenawan volcanic

rocks (for example, the North Shore Volcanic Group of Green (1971) in Minnesota, the Osler Group ion Ontario, and the volcanic rocks of the South Trap Range in westernmost Michigan), which in turn overlie a complex terrane of older Precambrian igneous and metamorphic rocks. The Keweenawan lavas were probably erupted somewhat more than a billion years ago from a rift system in the axial region of the basin and spread laterally to form extensive sheets, some of which must have covered thousands of square miles. The basin was actively subsiding during the eruptive period; during intermittent intervals of volcanic quiescence sedimentary debris was washed from adjacent highlands into the basin to form the clastic rocks interbedded with volcanic flows. When volcanic activity ceased, the basin continued to subside long enough for deposition of the Copper Harbor Conglomerate and of still higher sedimentary formations exposed south of Lake Superior.

From the end of the Keweenawan until the glacial epoch, little is known about the geologic history of Isle Royale, and indeed of much of the Lake Superior region. Some of the rocks of the Bayfield group in the central Lake Superior basin may be of Cambrian age, but no younger preglacial rocks are known from that area. Younger Paleozoic rocks extend northward from central Michigan to the southeast shore of Lake Superior and southward from Hudson Bay to within 100 miles of the north shore of the lake. If these younger rocks once extended across this gap, they were probably removed by erosion long before the glacial epoch.

GLACIAL AND POSTGLACIAL GEOLOGIC HISTORY

Differential resistance of individual units or zones within the tilted bedrock formations controlled the physiographic development of Isle Royale, and the pronounced ridge-and-valley topography that resulted was formed by stream erosion prior to glaciation. The main role of subsequent glacial erosion was to accentuate asymmetry of the existing ridge-and-valley land surface and to interrupt the preglacial streams with aligned bedrock lake basins. Because of the northerly location of Isle Royale, each successive glaciation overrode and essential obliterated all direct evidence of preceding glaciations on the island. It is to the last major readvance of the ice sheet during Valderan time, about 11,000 years ago, that the final aspect of the morphology of Isle Royale is largely attributable.

As the Valderan ice withdrew northward, a series of lakes formed in the Lake Superior basin at the margin of the retreating ice. As the retreating ice opened successively lower outlets, the general trend of lake elevations was downward. Periods of relative stability are reflected by distinct lake stages during which well-defined shoreline features were developed. During one pause in its retreat, the ice margin remained across Isle Royale west of Lake Desor. Abundant deposits of glacial debris were left upon the newly deglaciated western end of the island, and the ice front remained stable long enough to build a complex of ice-margin deposits across the island. Subsequent renewed and complete retreat of the ice margin from Isle Royale was rapid enough to leave only a small amount of glacial debris on the central and eastern parts of the island.

Except for wave-cut shoreline features, postglacial modification of the topography has been very slight. Materials derived from slope erosion are transported only very short distances, owing to low stream gradients and innumerable beaver dams. Bogs and swamps occupy much of the alluvial valley bottoms.

Text from source map: Isle Royale National Park

Selected References

Dorr, J.A., Jr., and Eschman, D.F., 1970, Geology of Michigan: Arbor, Univ. Michigan Press, 476 p.

Green, J.C., 1971, The North Shore Volcanic Group in Inst. Lake Superior Geology, 17th Ann., Duluth, Minnesota, 1971, Tech. Sess. Abs. and Field Guides: Duluth, Minnesota, Univ. of Minn., Duluth, p. 74-96

Halls, H.C., 1966, A review of the Keweenawan geology of the Lake Superior region, in The earth beneath the continents—A volume of geophysical studies in honor of Merle A Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.-Natl. Research Council Pub. 1467). P. 3-27.

Huber, N.K., 1973, Glacial and postglacial geologic history of Isle Royale National Park, Michigan: U. S. Geol. Survey Prof. Paper 754-A, 15p.

Huber, N.K., 1973, The Portage Lake Volcanics (Middle Keweenawan) on Isle Royale, Michigan: U.S. Geol. Survey Prof. Paper 754-C.

Huber, N.K., 1973, The Geologic Story of Isle Royale National Park: U.S. Geol. Survey Bull. 1309.

Lane, A.C., 1898, Geological report on Isle Royale, Michigan: Michigan Geological Survey, v. 6, pt. 1, 281 p.

Kelley, R.W. and Farrand, W.R., 1967, The glacial lakes around Michigan: Michigan Geol. Survey Bull. 4, 23 p.

White, W.S., 1960, The Keweenawan lavas of Lake Superior, an example of flood basalts: Am. Jour. Sci., 258-A, Bradley Volume, p. 367-374.

Wolff, R.G., and Huber, N.K., 1973, The Copper Harbor Conglomerate (middle Keweenawan) on Isle Royale, Michigan, and its regional implications: U.S. Geol. Survey Prof. Paper 754-B, 15 p.

Zumberge, J.H., 1955, Glacial erosion in tilted rock layers: Jour. Geology, v.63, no. 2, p. 149-158.

References from source map: Isle Royale National Park

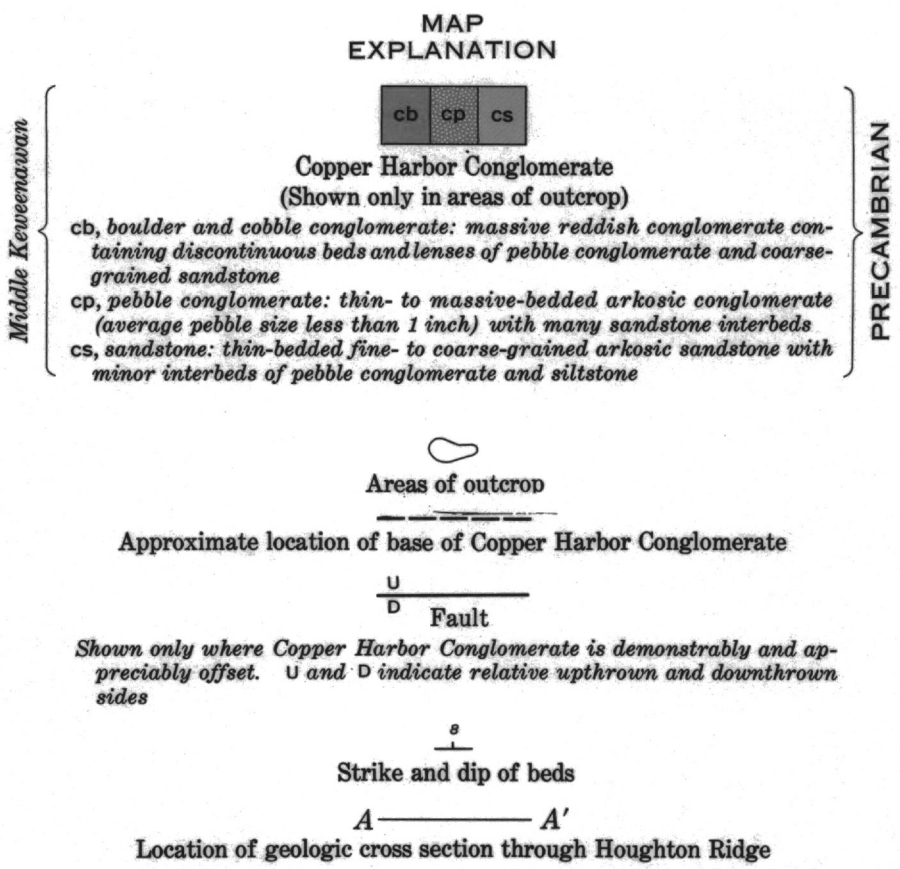
Copper Harbor Conglomerate on Isle Royale

The formal citation for this source.

Wolff, R.G., and Huber, N.K., 1973, The Copper Harbor Conglomerate (middle Keweenawan) on Isle Royale, Michigan, and its Regional Implications: U.S. Geological Survey, Professional Paper 754-B, scale 1:62,500 (*GRI Source Map ID 4951*).

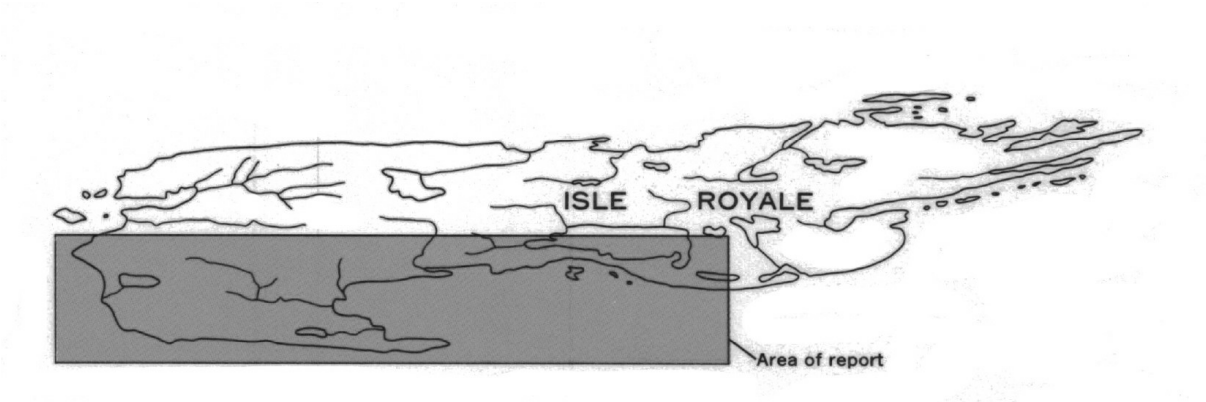
Prominent graphics and document associated with this source.

Map Explanation



Graphic from source map: Copper Harbor Conglomerate on Isle Royale

Area of Report



Graphic from source map: Copper Harbor Conglomerate on Isle Royale

Document (Report Booklet)

The document (report) for "Geology of Isle Royale National Park, Michigan" for U.S. Geological Survey Professional Paper 754-B (Copper Harbor Conglomerate on Isle Royale) is provided as an embedded document. To access the document double-click the follow embedded document link: usgs_pp-754-b_document.pdf.

The document's contents, illustrations and tables.

CONTENTS

	Page
Abstract	B1
Introduction	1
Scope of study	1
Acknowledgments	2
Copper Harbor Conglomerate on the Keweenaw Peninsula of Michigan	3
Copper Harbor Conglomerate on Isle Royale	4
Location and areal extent	4
Thickness	5
Lithologic character	7
Texture	7
Copper Harbor Conglomerate on Isle Royale—Continued	
Lithologic character—Continued	
Composition	B7
Distribution of rock types	8
Direction of sedimentary transport	10
Sedimentary structures as directional indicators	10
Lateral changes in texture and formational thickness as directional indicators	11
Conglomerate composition as an indicator of source direction	12
Environment of sedimentary accumulation	13
References cited	14

ILLUSTRATIONS

		Page
PLATE	1. Map and structure section of the Copper Harbor Conglomerate on Isle Royale, Michigan	In pocket
FIGURE	1. Sketch map showing generalized distribution of Keweenawan rocks in the Lake Superior region	B2
	2. Chart showing nomenclature for middle and upper Keweenawan rocks of northern Michigan and adjacent parts of Wisconsin	3
	3. Sketch map showing distribution of the Copper Harbor Conglomerate and paleocurrent directions on the Northern Peninsula of Michigan	5
	4. Stratigraphic diagram of the Copper Harbor Conglomerate on Isle Royale from Rainbow Point to Francis Point	6
	5–13. Photographs showing:	
	5. Boulder and cobble conglomerate at Cumberland Point	7
	6. Pebble conglomerate overlying basalt on Hat Island in Malone Bay	9
	7. Sandstone overlying basalt at small cove north of Schooner Island	9
	8. Cobble conglomerate facies and pebble conglomerate facies on west end of Feldtmann Ridge	9
	9. Sandstone facies on Stone House Island	10
	10. Longitudinal section of trough-type crossbedding in sandstone on the southern side of Houghton Ridge	10
	11. Cuspate ripple markings in sandstone on shoreline in sec. 18, T. 63 N., R. 37 W	11
	12. Asymmetric ripple markings in sandstone on shoreline south of Fishermans Home Cove	11
	13. Current-crescent structures in sandstone on shoreline south of Fishermans Home Cove	11
	14. Map of sediment dispersal patterns in the Copper Harbor Conglomerate on Isle Royale	12
	15. Photograph of desiccation cracks in fine-grained sedimentary rock on Menagerie Island	13

TABLES

		Page
TABLE	1. Composition of pebble conglomerate	B8
	2. Composition of coarse to very coarse grained sandstone	8
	3. Composition of very fine to fine grained sandstone	8
	4. Composition of very fine grained standstones, very coarse grained sandstones, and pebble conglomerates taken from the measured section on Houghton Ridge	10
	5. Relative abundance of sedimentary features in sandstone and pebble conglomerate in the Copper Harbor Conglomerate, Isle Royale	11

Graphic from source map: Copper Harbor Conglomerate on Isle Royale

GRI Digital Data Credits

This document was developed and completed by Stephanie O'Meara (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Ron Karpilo (Colorado State University).

The information in this document was compiled from GRI source maps, and is intended to accompany the digital geologic-GIS map and other digital data for Isle Royale National Park, Michigan (ISRO) developed by Anne Poole (NPS GRD) and Stephanie O'Meara (see the GRI Digital Map and Source Map Citations section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS map).

GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Jason Kenworthy and Tim Connors (NPS GRD, Lakewood, Colorado).