Surficial ("Pleistocene") Geologic Map Unit Properties Table: Apostle Islands National Lakeshore

Map unit colors correspond to GRI map poster (in pocket). Bold text refers to sections in report.

Age	Map Unit (Symbol)	Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
QUATERNARY (Holocene)	Postglacial deposits, shoreline sediment (**Qc**)	**Qc** consists of well-sorted sand and gravel. **Qc** occurs along the shoreline of Lake Superior and no more than a few meters above the present lake level. Long Island is composed entirely of **Qc**. **Qc** is also mapped on Rocky, Outer, Michigan, and Stockton islands.	**Sandscapes**—**Qc** is the primary unit composing the dynamic sandscapes within the lakeshore. **Recent Surficial Deposits**—**Qc** is still collecting and being reworked on the shores of the Apostle Islands by coastal processes. **Sedimentary Rock Features**—modern features in **Qc** such as ripple marks reflect the ancient features in solidified bedrock of the Bayfield Group (**PCdi**, **PCch**, and **PCo**).	**Shoreline Response to Lake-Level Change**—**Qc** is vulnerable to considerable erosion. Sandscapes would decline with rising lake levels. High water caused loss of beach area at Outer Island in spring 2014.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qc** reflects the ongoing processes of weathering and erosion along the shores of Lake Superior. **Qc** was deposited after about 5,000 years ago.
QUATERNARY (Holocene)	Miller Creek Formation, windblown sediment (**Qw**)	**Qw** consists of well-sorted sand. Deposits of **Qw** can reach several meters thick. When enough sand is present, transverse dunes with northward-sloping slip faces form locally. **Qw** is not mapped within Apostle Islands National Lakeshore.	**Aeolian Processes—Qw** forms as wind transports away the finer-grained components. Individual sand grains move via saltation (series of little hops) in the wind.	**Shoreline Response to Lake-Level Change**—**Qw**, where present along the shoreline, is prone to erosion when lake levels drop.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qw** reflects the ongoing processes of weathering and erosion along the shores of Lake Superior. **Qw** was deposited after about 9,500 years ago following the final retreat of glaciers from the Lake Superior basin and prior to significant vegetation.
QUATERNARY (Holocene and Pleistocene)	Miller Creek Formation, shoreline sediment, offshore sediment (**Qb**)	**Qb** consists of well-sorted sand and gravel in deposits between 1 and 10 m (3 and 30 ft) thick. **Ob** appears as a series of beach ridges (i.e., lines in the GRI GIS geologic map data). **Qb** is not mapped within Apostle Islands National Lakeshore.	**Glacial Features**—**Qb** is well-sorted beach material that collected on the shores of a series of proglacial lakes.	None reported.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qb** was deposited between about 11,500 and 9,500 years ago as beach deposits on a series of proglacial lakes. **Qb** was deposited after about 9,500 years ago following the final retreat of glaciers from the Lake Superior basin and prior to significant vegetation.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
QUATERNARY (Holocene and Pleistocene)	Miller Creek Formation, till—valley sides (**Qgh**) Miller Creek Formation, till—lake-modified glacial topography (**Qgl**) Miller Creek Formation, till—wave-planed topography (**Qgw**)	Till is unsorted clay, silt, sand, gravel, and boulders (glacial sediment) deposited directly from glacial ice. In general, the Miller Creek Formation is redder in color and richer in clay content than the Copper Falls Formation. **Qgh** is mapped where steep slopes (10° to 15°) cut into the Miller Creek till. Deposits of **Qgl** are of low relief with some hummocky and collapsed (soft-sediment deformation) areas. **Qgl** is commonly 1 to 20 m (3 to 6 ft) thick. **Qgw** occurs on higher and steeper part of the Superior lowland than **Qgl** and was subjected to less wave energy. In less-eroded areas, 1 m (3 ft) of nearshore sand overlies **Qgw**. **Qgl** and **Qgw** are the primary surficial geologic units mapped within Apostle Islands National Lakeshore.	**Glacial Features**—in areas where broad hillsides are exposed as **Qgh**, Miller Creek till, offshore and stream sediment, and Copper Falls till are visible. The hummocky topography of **Qgl** was subdued by wave action, or by being deposited in water-saturated conditions with soft-sediment collapse. Drumlins are mapped in **Qgl**. **Slope Movements—Qgh** features slope wash and slope-movement deposits at the base of hillslopes. Landslides are common.	**Shoreline Response to Lake-Level Change**—**Qgl** and **Qgw** weather to provide sediment to the sandscapes within Apostle Islands National Lakeshore. **Slope Movement Hazards and Risks—Qgl**, **Qgh**, and **Qgw** are prone to slope wash and landslides.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qgh**, **Qgl**, and **Qgw** were deposited between about 11,500 and 9,500 years ago. Wave action from Lake Superior modified **Qgl**.
	Miller Creek Formation, uncollapsed offshore sediment (**Qou**)	**Qou** consists of finer-grained, offshore sediments with horizontal bedding. **Qou** exhibits flat topography. **Qou** is not mapped within Apostle Islands National Lakeshore.	**Fluvial Features**—the Sand River valley cuts through **Qou** on its course to Lake Superior. **Glacial Features**—**Qou** was deposited on solid ground and was not subject to soft sediment deformation caused by collapse of any underlying ice melting.	**Slope Movement Hazards and Risks—Qou**, as part of the Miller Creek Formation, is prone to slope wash and landslides.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qou** was deposited between about 11,500 and 9,500 years ago.
	Postglacial deposits, organic sediment (**Qp**)	**Qp** consists of peat or mixtures of organic deposits and fine-grained material in layers between less than 1 m (3 ft) and a few meters thick. Bedding is typically flat. **Qp** is mapped on Sand and Stockton islands.	**Recent Surficial Deposits**—**Qp** accumulated in low-lying swamps, bogs, and marshes. **Paleontological Resources**—**Qp** may contain fossil pollen recording conditions since the last major glaciation of the Pleistocene Epoch.	None reported.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qp** accumulated in marsh areas since about 10,000 years ago.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
QUATERNARY (Holocene and Pleistocene)	Postglacial deposits, stream sediment (**Qsm**)	**Qsm** consists of sand and gravel in overlapping channel deposits (i.e., trough-shaped deposits in cross section). Most deposits of **Qsm** are more than 1 m (3 ft) thick and may be overlain by silt and clay that were overbank deposits. This pattern is typical of meandering streams and adjacent floodplains. **Qsm** is mapped along the shoreline of the mainland unit of Apostle Islands National Lakeshore at the mouth of the Sand River.	**Fluvial Features**—**Qsm** is being deposited at the mouth of the Sand River. Deposits compose terraces and floodplains along the active channel. **Recent Surficial Deposits**—**Qsm** still accumulates in the channels and adjacent floodplains of modern streams.	**Fluvial and Other Surface Water Issues**—**Qsm** is deposited by the Sand River within Apostle Islands National Lakeshore. **Qsm** is unconsolidated and prone to erosion as the river meanders across its floodplain.	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qsm** has accumulated in stream channels and floodplains since about 10,000 years ago.
QUATERNARY (Pleistocene)	Copper Falls Formation, collapsed proglacial stream sediment (**Qsc**) Copper Falls Formation, hummocky stream sediment overlain by silty material (**Qsg**) Copper Falls Formation, uncollapsed proglacial stream sediment (**Qsu**) Copper Falls Formation, uncollapsed proglacial stream sediment—Valhalla surface (**Qsuc**)	**Qsc** formed as mixed stream sediments deposited atop glacial ice. As the ice melted, the sediments collapsed, resulting in faulted bedding and hummocky collapse topography. Surface boulders are rare in **Qsc**. **Qsg** is collapsed stream sediments mixed with till or windblown or offshore sediments and underlying stream sediments. Surface boulders are common in **Qsg**. **Qsu** and **Qsuc** consist of poorly sorted, coarse sediments with undisturbed bedding surfaces. **Qsu** and **Qsuc** exhibit flat topography and no surface boulders. None of these units is mapped within Apostle Islands National Lakeshore.	**Glacial Features**—**Qsc** was deposited on stagnant ice and collapsed when the underlying ice melted. Proglacial streams deposited **Qsg**. **Qsu** and **Qsuc** were deposited on solid ground and were not subject to soft sediment deformation or collapse.	None reported	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qsc**, **Qsg**, **Qsu**, and **Qsuc** were deposited between about 16,000 and 11,500 years ago. Several stability surfaces are present as part of **Qsu**: Lost Lake, Iron River, Valhalla, Lake Ruth, Airport, Swiss, Hayward, and Tiger Cat surfaces.
QUATERNARY (Pleistocene)	Copper Falls Formation, till – thick mass-movement deposits (**Qgg**)	Different types of tills reflect the method of their deposition. Lodgement till is deposited by plastering of glacial debris from the sliding glacial ice. Mass-movement tills are tills that were subject to slope movements after initial deposition. Melt-out tills are released by the melting of stagnant or slowly moving ice without subsequent sedimentary transport or soft-sediment deformation. **Qgg** occurs as mass-movement till, some melt-out till, and lodgement till that covers and obscures older till deposits. In general, the Copper Falls Formation is reddish to brownish sandy sediment. Topography of **Qgg** is hummocky with abundant surface boulders. **Qgg** is not mapped within Apostle Islands National Lakeshore.	**Glacial Features**—**Qgg** displays hummocky topography and three different types of glacial till.	None reported	**66 Million Years Ago to Present (Cenozoic Era)—Erosion, Ice Age Glaciation, and Rebound**—**Qgg** was deposited between about 16,000 and 11,500 years ago.

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CAMBRIAN–PROTEROZOIC	Bedrock (**CPCrs**)	**CPCrs** includes sandstone, mudstone, and conglomerate of **PCch**, **PCdi**, **PCo**, and **PCf** (see Bedrock Geologic Map Unit Properties Table). **CPCrs** is mapped at Bear and Rocky islands.	See Bedrock Geologic Map Unit Properties Table.	See Bedrock Geologic Map Unit Properties Table.	See Bedrock Geologic Map Unit Properties Table.