Classification of Lithic Material Types in Artifact Collections from Archaeological sites in Alberta

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Lithic Raw Materials

- **Identification** and **sourcing** of materials used for the production of stone tools is important in order to better understand the knapping process (including acquisition and stone selection), settlement patterns, seasonal migration, cultural contact, trade networks, economics, and ethnicity.

- The best quality stone materials for flaked tool production:
  - Are **fine-grained** (micro or cryptocrystalline) - the minerals are not visible with the naked eye, or **amorphous** - no mineral structure;
  - Fracture **concoidally** – the percussion force moves through the material evenly, in a cone shape that spreads out as the force moves down from the point of impact. The force does not follow the natural planes of separation (if present);
  - Fracture with very sharp edges;
  - Have a homogeneous mineralogy with few inclusions.

Raw Material Classification

- Raw material types are typically macroscopically assessed on the basis of:
  - **Texture:** The size, shape, and organization of the rock particles;
  - **Colour:** The concentration and texture of the elements present in the rock determine the colour(s) of the raw material;
  - **Luster:** The way the rock surface appears in reflected light. Luster is connected to the texture and mineralogical constituents of the rock;
  - **Translucency:** The degree to which a material can transmit light.
- Each of these attributes have a number of defined grades or categories.
- The attributes and combination of attributes reflect the raw material type.

Textural Grades

- **Very coarse-grained**: Individual grains are clearly visible with the naked eye. Non-cortical facets are abrasive to the touch.
- **Coarse-grained**: Individual grains are visible with the naked eye or a hand lens. The particles are compacted or the voids between particles are filled in to create a less abrasive surface.
- **Medium-grained**: Individual grains may be visible with the naked eye but a hand lens is necessary to distinguish them. A slightly abrasive surface can be felt.
- **Fine-grained**: Individual grains are distinguishable with a hand lens. The flaked surface is smooth, though not polished-like.
- **Very-fine grained**: Individual grains are not detectable without a microscope. The flaked surface is very smooth and feels polished.
- **Amorphous**: The stone material has a non-granular glassy texture.

Colour Classification

- Defining colour is a subjective process, therefore, a list of colours created in conjunction with the Munsell colour system is used. This system incorporates the hue, value (lightness), and chroma (purity) of the colour. Munsell colours are coded as: hue value/chroma.
- The colour of the non-cortical (interior) and cortical (exterior) aspects of the stone should be recorded.
- The primary colour of the rock (the most prevalent colour) should be identified along with secondary colours if applicable.
- The most common lithic colours with their range of Munsell codes in brackets are:

Translucent (colourless)
White (Gley 1 8/N)
White – Light grey (Gley 1 7/N)
Light grey (Gley 1 6/N)
Medium grey – Light grey (Gley 1 5/N)
Medium grey (Gley 1 4/N)
Dark grey (Gley 1 3/N)
Black (Gley 1 2.5/N)
Brown (7.5 YR 2.5-5/2-6; 10YR 2-7/2-8; 2.5 Y 3-6/2-8; 5Y 3-6/2-6)
Yellow (2.5 Y 6-8/3-8; 5Y 6-8/3-8)
Green (Gley 1 2.5-8/10Y-5G; 5Y 2.5-6/2-8)
Orange (5YR 4-8/3-8; 7.5 YR 5-8/3-8)
Pink (10R 7-8/1-8; 2.5 YR 7-8/1-8)
Red (10R 2.5-6/1-8; 2.5 YR 2.5-6/1-8)
Purple (Gley 2 2.5-8/5B-5PB)

Luster Categories

- **Vitreous:** Light directly reflects off the surface of the rock. These rocks have the same luster as glass.
- **Resinous:** Some light is directly reflected off the surface of the rock. These rocks have the appearance of resin or plastic.
- **Waxen:** Most light is not directly reflected off the surface of the rock. Its luster is similar to that of wax. Heat treating the raw material often creates or accentuates a waxy luster.
- **Dull:** Light scatters in all directions; no reflection is seen. The rock exhibits no luster.

Vitreous

Resinous

Waxen

Dull

Translucency Categories

- **Opaque:** No light is transmitted through the lithic material no matter how thin the specimen is.
- **Slightly translucent:** Only a limited amount of light is transmitted through the rock or mineral, often only through thin sections.
- **Moderately translucent:** A moderate amount of light is transmitted through even thick sections of the lithic material.
- **Highly translucent:** A high amount of light is transmitted through even thick sections of the specimen.
- **Translucent:** The lithic material is fully translucent.

Opaque

Moderately translucent

Highly translucent

Raw Material Types

- **Igneous Rocks**

  Intrusive and extrusive rock formed from volcanic magma or lava respectively.

  The faster the cooling process the finer the mineralogical structure.

  - **Obsidian**: Rapid cooling, crypto-crystalline. Extrusive.
  - **Basalt**: Rich in ferromagnesian minerals, fine-grained crystals. Extrusive.
  - **Massive Quartz:** Silica crystals that form within cooling molten rock.
  - **Granite**: Slow cooling with large crystals. Intrusive

- Obsidian was a highly desired material due to is crypto-crystalline structure. It is relatively easy to knap and a very sharp edge can be created.

- Granite is too hard to knap but nodules of this stone may have served as hammerstones. Granite cobbles were also modified into groundstones (mauls, manos, matates) in later periods.

Raw Material Types

- **Sedimentary Rocks**

  Rock formed through diagenesis, typically by the pressure of overlying deposits.

  - **Mudstone**: lithified clay particles.
  - **Siltstone**: lithified silt particles.
  - **Sandstone**: lithified sand particles.
  - **Conglomerate**: lithified gravels.
  - **Limestone** and **dolomite**: lithified carbonates.
  - **Chert**: replacement silica mineral through diagenesis (silicate rock).

- With the exception of chert, sedimentary rocks were not typically used for flaked stone tools as they lack internal cohesive strength.

- Many of these rocks can become metamorphic rocks if the silica present cements the stone as a result of heat and pressure (siltstone becomes silicified siltstone, for example).

Raw Material Types

- **Silicate Rocks and Minerals**

  Rocks that consist primarily of silicate minerals that formed as a result of diagenesis.

  – **Chert**: Precipitation of silica in cavities or veins of other rocks (sedimentary rock).
    - Cryptocrystalline silicate of equidimensional crystals.
    - 99% silica and less than 1% extracrystalline water.
    - **Flint** is a type of chert that forms as nodules in beds of chalk, limestone, or marl.

  – **Chalcedony**: precipitation of silica.
    - Fewer impurities than chert.
    - Between 1 and 9% extracrystalline water.
    - Radiating and fibrous nature in thin section.
    - Higher translucency than chert

  – **Opal**: Replacement of organic material with silica in the fossilization process.
    - Amorphous silicate with more than 10% extracrystalline water.

  – **Silicified wood:** Replacement of carbonaceous particles in wood with silica (chalcedony or opal). Typically referred to as **petrified wood**.

- Silicate rocks were commonly used to create flaked tools because of their cryptocrystalline to amorphous structure and homogeneity.

Raw Material Types

- **Metamorphic Rocks**

  Altered rock via pressure and heat.

  - **Silicified siltstone/mudstone:** Silica is deposited or replaces other elements through metamorphous.
  - **Argillite:** Weakly metamorphosed shale, siltstone, and mudstone.
  - **Porcellanite**: Fine-grained silicified clay, often connected to coal seams.
  - **Quartzite**: Metamorphosed sandstone via silica cementation.
  - **Gneiss**: Banding produced when different textural minerals within granite (granular vs. prismatic) undergo metamorphic alteration. Differential pressures are created.
- Silicified siltstone/mudstone and argillite were commonly used to create flaked stone tools.
- Quartzite was also selected for because of it availability in Alberta, though due to its macro-crystalline structure, it is less workable than other materials.
- Gneiss is too hard to knap but nodules of this stone may have served as hammerstones.

Obsidian

- **Definition**
  - Extrusive, igneous, fast cooling rock
- **Texture**
  - Very fine-grained (glass-like)
- **Material Colours**
  - Black to dark grey
  - Orange banding
  - Green, purple, red undertones
  - Grey to white ash inclusions
- **Luster**
  - Vitreous
- **Translucency**
  - Opaque to highly translucent
- **Sources**
  - Obsidian Cliff in Yellowstone National Park, Glass Butte in Oregon, Bear Gulch in Idaho and deposits in the Rockies of British Columbia.
  - Sourceable based on mineralogy.

Basalt

- **Definition**
  - Extrusive, igneous rock
- **Texture**
  - Course to fine-grained
  - Similar to black chert but can be distinguished by the presence of small volcanic glass shards and vesicles.
- **Colour**
  - Black to dark grey

- **Luster**
  - Dull or vitreous
- **Translucency**
  - Opaque
- **Sources**
  - Tertiary basalts may have been acquired from central Montana, Washington or British Columbia.
  - Coarser grey basalt likely came from the Midvale Basalt Quarry in western Idaho.

Massive Quartz

- **Definition**
  - Coarsely crystalline quartz silicate.
  - Formation of freestanding six-sided quartz crystals that are often twinned or distorted to the point that they lack obvious crystal facets, thereby appearing massive.
- **Texture**
  - Quartz minerals
  - Fractures along facets
- **Material Colour**
  - Clear
  - White
  - Occasional tinges of pink, yellow, or black
- **Luster**
  - Vitreous
- **Translucency**
  - Highly translucent
- **Sources**
  - Secondary alluvial deposits and glacial tills.
  - Quarries in southern BC and Montana.

Granite and Gneiss

- **Definition**
  - Intrusive, igneous rock
  - The slow cooling of magma allows large crystals to form, which gives granite its unique mineralogical and chemical components.
  - **Gneiss** is metamorphically altered granite recognized by clear internal banding.
- **Texture**
  - Course-grained
  - Contains quartz, feldspar, and mica
  - Heterogeneous

- **Colour**
  - Can have a variety of colours within a single nodule
  - White, pink, orange, grey, purple.
- **Luster**
  - Vitreous to waxen

- **Translucency**
  - Opaque
- **Sources**
  - Locally available in secondary alluvial and glacial surface deposits.
  - Many of the granite cobbles in Alberta originated from the Canadian Shield.

Limestone and Dolomite

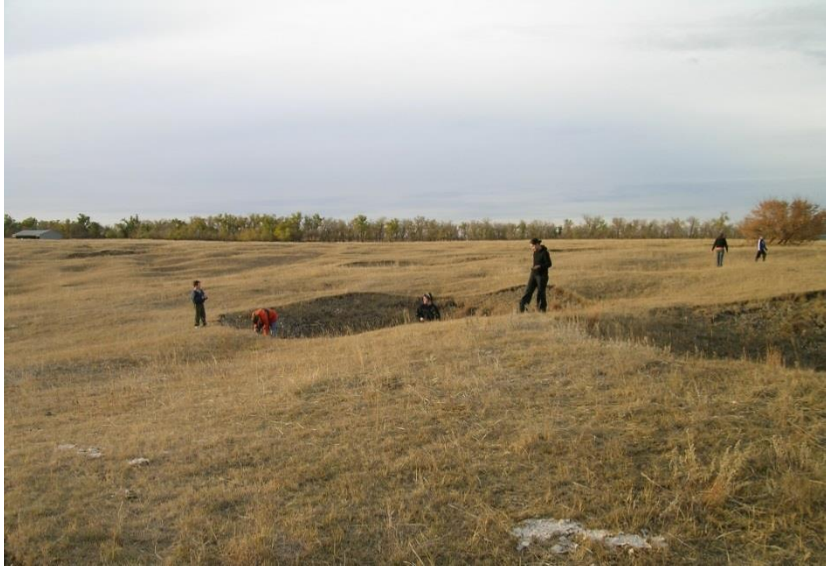
- **Definition**
  - Sedimentary rock composed of calcium magnesium carbonate ($CaMg(CO_3)_2$).
  - Dolomite may be distinguished from limestone because it does not react as vigorously with diluted (10%) hydrochloric acid (HCl).
- **Texture**
  - Medium to fine-grained
  - Texture is created when the carbonates crystalize
- **Colour**
  - White
- **Luster**
  - Dull to waxen
- **Translucency**
  - Opaque
- **Sources**
  - Rocky Mountains
  - Secondary alluvial and glacial deposits

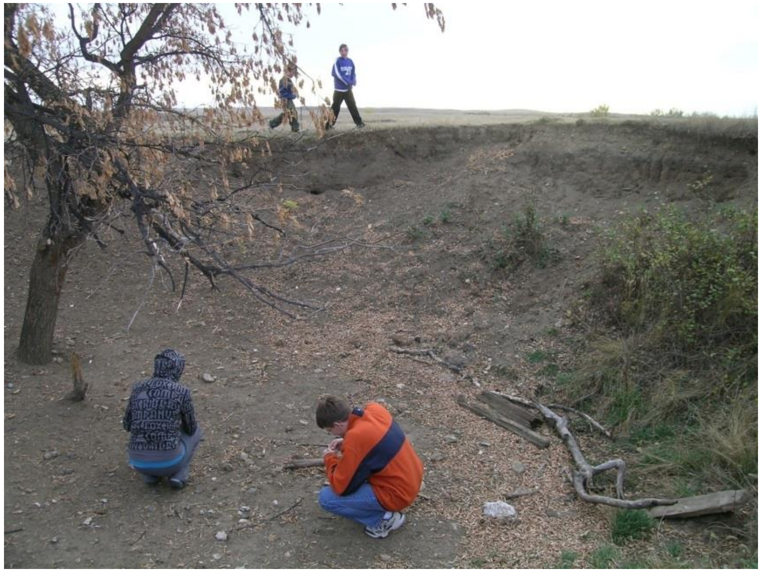
Knife River Flint (chert)

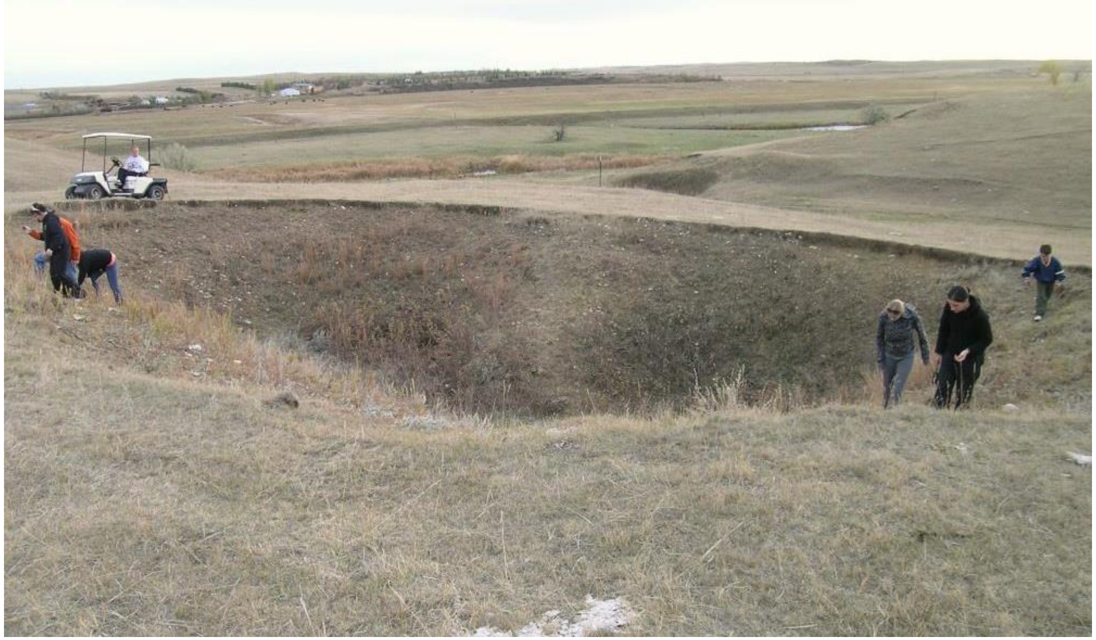
- **Definition**
  - Chert silicate created when silica gradually replaced the organic matter and filled the pores of a peat deposit in North Dakota 60 and 30 million years ago.
- **Texture**
  - Very fine-grained
  - Can have pieces of peat (plant microfossils) still present or the modular structure of peat.
- **Material Colour**
  - Deep brown to amber
  - May have a white patina which gives the stone a bluish tinge.
  - Homogeneous to mottled
  - Fluoresces faint orange when subjected to UV shortwaves.
- **Luster**
  - Vitreous
- **Translucency**
  - Moderate to high
  - Can have opaque or completely translucent spots

- **Sources**
  - Surface collected and mined from secondary alluvial deposits in the Dunn and Mercer counties of North Dakota (Knife River Flint Quarries).
  - KRF made its way into assemblages found hundreds of kms away.
  - Was the most widely used raw material in the northern Great Plains.

Knife River Flint Quarries, North Dakota







Swan River Chert

- **Definition**
  - Chert silicate
  - Usually heat treated for knapping
- **Texture**
  - Heterogeneous
  - Medium to very fine-grained
  - Vugs (small, irregularly shaped holes that may be filled with quartz crystals)
  - Microfossil inclusions (feather-like or needle-like)
- **Material Colour**
  - Mottled, curdled milk appearance (signature attribute)
  - White, light to medium grey
  - Brown and yellow
  - Orange, red, and purple (heat treatment changes the colour of the stone)
- **Luster**
  - Dull to vitreous
  - Waxen if heat treated
- **Translucency**
  - Opaque
  - Slightly to moderately translucent
- **Sources**
  - Outcrops in the Swan River valley, west-central Manitoba.
  - Secondary deposits of cobbles in alluvial and glacial deposits throughout southern Saskatchewan and Alberta, and possibly into northern Montana and Iowa.

Montana Cherts

- **Definition**
  - Chert silicate
- **Texture**
  - Very fine-grained
  - May have dendrites or inclusions
- **Material Colour**
  - Highly variable
  - Solid and mottled colours
    - Yellow and brown
    - Dark grey to black
    - Green
    - Red
  - Colour is typically used to separate Montana Chert subtypes.
  - Can be patinated
- **Luster**
  - Vitreous
- **Translucency**
  - Opaque
- **Sources**
  - Maddison Limestone Formation in Montana
  - Secondary alluvial deposits

Etherington Chert

- **Definition**
  - Chert silicate
- **Texture**
  - Fine to medium-grained
  - Distinct sugary texture
  - Drusy quartz infills and microfossils are present
  - Flake scars can by milky, fish scale-like
- **Material Colour**
  - White to light grey patinated surface
  - Mottled colours
    - Greys
    - Purples
    - Browns
    - Reds
- **Luster**
  - Vitreous to dull
- **Translucency**
  - Opaque to slightly translucent
- **Sources**
  - Nodules are found in a limestone/dolomite matrix in the Livingston Range in the Rockies of southern Alberta.
  - Etherington Chert is similar to chert from the Bear Paw Mountains in northern Montana.

Top of the World Chert

- **Definition**
  - Chert silicate encased in limestone
- **Texture**
  - Cryptocrystalline
  - Microfossils (dark; some partly or completely replaced by silica)
- **Material Colour**
    - Mottled colours
    - White
    - Light to dark grey
    - Black
  - Dendrites, irregular banding, and speckling are common.
- **Luster**
  - Vitreous
- **Translucency**
  - Moderately to highly translucent
- **Sources**
  - High plateau (2,134 m asl) in the Rocky Mountains of southeastern BC.
  - Nodules are small due to the highly bracciated nature of the source lenses.

Pebble Chert

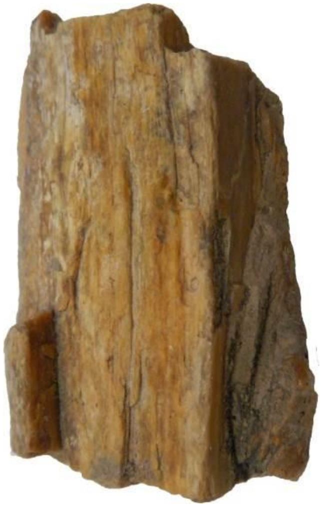
- **Definition**
  - Chert silicate
  - Pebble-sized with a black, polished cortex
- **Texture**
  - Fine-grained to cryptocrystalline
- **Material Colour**
  - Black
  - Grey
  - Dark brown
- **Luster**
  - Vitreous to resinous
- **Translucency**
  - Opaque
- **Sources**
  - Outcrops in the Alberta and Montana Foothills.
  - Consort Pebble Chert quarry in central Alberta.
  - Secondary alluvial and glacial deposits.

Chalcedony

- **Definition**
  - Silicate composed of quartz and moganite.
  - Between 1 and 9% extracrystalline water.
  - **Agate (Jasper)** is a multi-coloured, banded variety of chalcedony.
- **Texture**
  - Cryptocrystalline
  - Radiating fibrous nature in thin section
- **Material Colour**
  - Wide range of colours
    - White to grey
    - Yellows and browns
    - Reds and oranges
  - May have banding or dendrites
- **Luster**
  - Vitreous to resinous
- **Translucency**
  - Slightly translucent to translucent
- **Sources**
  - Small nodules can be found in secondary alluvial and glacial deposits originating from the Rockies.

Silicified (Petrified) Wood

- **Definition**
  - Carbonaceous sediment (wood) fossilized by its replacement with silica.
  - Cellular structure of the organic material (wood) may still be seen.
- **Texture**
  - Fine to very fine-grained (micro-crystalline)
  - Clear banding tending to platy layers
  - Fracturing tends to follow the wood grain which produces tabular-like flakes and stepped terminations.
- **Material Colour**
  - Often somewhat heterogeneous
  - Yellows and browns
  - Dark red
  - Medium to dark grey
- **Luster**
  - Dull to Vitreous
- **Translucency**
  - Opaque to translucent
- **Sources**
  - Relatively common in secondary glacial and alluvial deposits throughout southern Alberta, Saskatchewan, and northern Montana.



Silicified Siltstone

- **Definition**
  - Silt particles of siltstone have been impregnated with high amounts of silica through metamorphosis, binding them together.
- **Texture**
  - Fine-grained
  - Silt particles are visible with the naked eye or hand lens
  - Vesicles are common as are irregular inclusions
  - Banding in many specimens

- **Material Colour**
  - Medium to dark grey
  - Browns

- **Luster**
  - Dull
- **Translucency**
  - Opaque
- **Sources**
  - Banff Formation (Silicified siltstone/Banff Chert) throughout the Rocky Mountains of the Northwest Territories, B.C., Alberta, and Montana.
  - Quarry near Creston, BC. (Elk River silicified siltstone).
  - Siltstone cobbles are commonly found in alluvial deposits in the drainages of the Rockies.

Silicified Mudstone

- **Definition**
  - Clay particles have been impregnated with high amounts of silica through metamorphosis, binding them together.
  - Distinguishing between silicified mudstone and dark cherts is difficult without laboratory testing. Black pebble chert has a slightly more vitreous luster.
- **Texture**
  - Very fine-grained
  - Clay particles are not visible with the naked eye or hand lens
  - Banding is rare
  - Generally very homogeneous
- **Material Colour**
  - Medium to dark grey
  - Black
- **Luster**
  - Dull to resinous
- **Translucency**
  - Opaque

- **Sources**
  - Mudstone pebbles and small cobbles are commonly found in alluvial deposits in the drainages of the Rockies.

Argillite

- **Definition**
  - Weakly metamorphosed mudstone, siltstone, or shale.

- **Texture**
  - Medium to fine-grained
  - Can be platy
  - Slightly courser than porcellanite
- **Material Colour**
  - Homogeneous, single colour
    - Dark red to brownish
    - Grey / green
    - Light green / light grey (Kootenay Argillite)
- **Luster**
  - Vitreous (reds and browns)
  - Dull to resinous (greys and greens)
- **Translucency**
  - Opaque
- **Sources**
  - Reddish argillites commonly occur in secondary gravel deposits throughout southern Alberta and northern Montana likely originating from large bedrock outcrops in the Rockies.
  - Green/grey argillites have been located in southeastern BC, southwestern Alberta, and northern Montana.
  - Kootenay Argillite comes from the Kootenay Lakes region in southeastern BC. It is very fine grained and has a slightly platy structure making it prone to step fractures.

Porcellanite

- **Definition**
  - Mixture of silty clay and carbonaceous deposits that were silicified with a large amount of silica.
  - Can occur above and below burned coal seams that burned, which metamorphologically altered the sedimentary rock to create fused shale.
- **Texture**
  - Fine-grained to very fine-grained (ceramic-like)
  - Can have small, irregular vesicles or tiny holes visible with a hand lens
  - Less hard and dense than chert
- **Material Colour**
  - Homogeneous, single colour
    - Medium to dark grey, black
    - Dark to medium red
- **Luster**
  - Dull to slightly vitreous
- **Translucency**
  - Opaque
- **Sources**
  - Large outcrops of high-quality porcellanite occur in southern Montana.

Beaver River Silicified Sandstone

- **Definition**
  - Silica-rich orthoquartzite created through secondary silicification of sandstone or quartzite
  - Also geologically defined as Muskeg Valley Microquartzite
- **Texture**
  - Course to fine-grained; cryptocrystalline between grains
  - Lacks microfossils
- **Material Colour**
    - Brown to orange
    - Light to dark grey
    - Mottled colours
  - Dendrites and speckling are common.
- **Luster**
  - Vitreous to waxen if heat treated
- **Translucency**
  - Opaque to slightly translucent
- **Sources**
  - Quarry of the Ancestors near Fort MacKay in northeastern Alberta

Quartzite

- **Definition**
  - Metamorphosed sandstone
  - Individual sand grains of sandstone rock are firmly cemented together.
  - Commonly used for lithic tool production.
- **Texture**
  - Generally homogeneous
  - Course to very course (coarse-grained quartzite)
  - Medium to fine-grained (medium/fine-grained quartzite)
- **Material Colour**
  - Typically homogeneous but some banding occurs
  - Yellows and browns
  - Reds and purples
  - Greys and greens
  - Heating alters the colour in most quartzite stones
- **Luster**
  - Vitreous
- **Translucency**
  - Opaque to slightly translucent
- **Sources**
  - Quartzite cobbles are commonly found in secondary alluvial deposits throughout the northern Great Plains region.

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