

# Saskatchewan's Clay Resources

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## What is Clay?

The term “clay” refers to a varied group of soft, fine grained earthy materials which become plastic when moist. Clay minerals derive from ancient igneous and metamorphic rocks which have been weathered and altered over time. Clay deposits usually contain other minerals such as quartz, calcite and mica which affect their chemical and physical properties.<sup>1</sup> Sometimes, when clay beds are reworked by the action of water, the components may be separated and redeposited in distinct beds.

In Saskatchewan, clays include such types as bentonite, brick and ceramic clays and kaolinite. Bentonites are soft waxy clays whose colours range from white through cream, reddish brown and blue, turning yellow upon exposure to air. They were formed through the weathering of volcanic ash or tuff which drifted some 70 millions years ago into a huge inland sea covering an area 1600 km wide from the present Arctic Ocean to Mexico. Other sources include igneous weathered igneous and sedimentary rocks. One type of bentonite, which contains sodium, has a unique ability to absorb a great deal of moisture, becoming very slippery and swelling to several times its dry volume.<sup>2</sup> The other, containing calcium, does not swell nearly so much.

Kaolinite mineral, commonly referred to as kaolin or china clay, is made up of individual crystals stacked in “booklets” of sheets.<sup>3</sup> An opaque white colour, when fairly pure, kaolin varies widely in composition and properties.

Glacial lake clays are crumbly semi-aggregates of a large particle size. Common clays, or brick clays, are a mixture of clays and a wide variety of minerals.

## Where Are Clays Found in Saskatchewan?

Glacial lake clays are widely scattered around the province. Extensive beds are found in the Regina and Saskatoon areas and between Unity and the Great Sand Hills close to the Alberta border.<sup>4</sup> Sodium bentonites are found in large deposits of the marine Bearpaw Formation in the Wilcox and Truax area, east of the Dirt Hills, and in the St. Victor area and Twelve Mile Lake near Pickthall.<sup>5</sup> Calcium bentonites have been found in the Ravenscrag and Battle Formations of southern Saskatchewan, near Pelly, Moosomin, Rockglen and Eastend.<sup>6</sup>

On top of the Bearpaw Formation, kaolin and ceramic clays are found in the non-marine bedrock Whitemud Formation of the Eastend, Wood Mountain, Readlyn, Willow Bunch and Rockglen areas and near Claybank in the Cactus and Dirt Hills.<sup>7</sup> This non-marine bedrock formation is an

<sup>1</sup> Saskatchewan Interactive, “Mining: Industrial Minerals,” Clay, University of Saskatchewan, [http://interactive.usask.ca/ski/mining\\_types/industrial/clay.html](http://interactive.usask.ca/ski/mining_types/industrial/clay.html)

<sup>2</sup> Saskatchewan Interactive, “Mining: Industrial Minerals,” Bentonite, University of Saskatchewan, [http://interactive.usask.ca/ski/mining/search/mineral\\_types/industrial/bentonite.html](http://interactive.usask.ca/ski/mining/search/mineral_types/industrial/bentonite.html)

<sup>3</sup> Saskatchewan Industry and Resources, “Mineral Resources of Saskatchewan,” Kaolin, <http://www.ir.gov.sk.ca/Default.aspx?DN=3554,3541,3538,3385,2936,Documents>

<sup>4</sup> Saskatchewan Interactive, Clay.

<sup>5</sup> Saskatchewan Industry and Resources, “Mineral Resources of Saskatchewan,” Bentonite, <http://www.ir.gov.sk.ca/Default.aspx?DN=3545,3541,3538,3385,2936,Documents>

<sup>6</sup> Ibid.

<sup>7</sup> Saskatchewan Industry and Resources, “Mineral Resources of Saskatchewan,” Clays, <http://www.ir.gov.sk.ca/Default.aspx?DN=3548,3541,3538,3385,2936,Documents>

extensive deposit which underlies much of southern Saskatchewan in the Cypress Hills area. The beds can be seen as striking white eroded outcrops. The Ravenscrag Formation, the source of coal in south central Saskatchewan, also contains large amounts of kaolin and related plastic clays.

### **How Are Clays Mined and Processed?**

Bentonite clay deposits are located and defined by drilling and sampling. Only those near the surface are worth mining. Large earth movers such as bulldozers and draglines carefully remove the overburden to avoid contaminating the bentonite below. This material is stockpiled and replaced after the bentonite has been mined layer by layer by bucket loaders or scrapers. The clay is sun-dried or kiln-dried and soda ash is added to it to improve its swelling properties.<sup>8</sup> It is then ground and bagged or stored in silos. It is shipped by truck or railcar in bulk or bags. Canadian Clay Products Inc. near Truax is Saskatchewan's only bentonite quarry operator and its processing plant at Wilcox produces about 80,000 tonnes of sodium bentonite each year.<sup>9</sup>

In accordance with Saskatchewan's treatment of mining as a temporary use of the land, when a clay deposit is mined out, reclamation is begun. The overburden is replaced and the surface returned to its original or better condition in order to leave the area suitable for sustainable plant and animal habitat.

Although there are extensive deposits of kaolin minerals in Saskatchewan, at present kaolin is not being produced as a pure commodity, but only as a natural component of ceramic and brick clays. The Whitemud Formation is made up of two layers, the lower of which, in the Wood Mountain area, contains about 50% - 60% kaolin which could be separated out and upgraded.<sup>10</sup> To do this, the raw ore or kaolinized sand must be crushed. The impurities must be physically and chemically removed. The kaolin would then be graded by grain size. Some of it could be calcined for special purpose uses. Saskatchewan's kaolin reserves have been estimated at nearly 200 million tonnes.<sup>11</sup>

### **What are Saskatchewan Clays Used For and Where Do They Go?**

Clays, with their varied physical and chemical properties, play an important role in many industries, including the construction, mining, manufacturing, artistic, chemical and oil and gas industries. At present, three major companies produce clay products in Saskatchewan.

Clays have been used for structural products since long before Saskatchewan was a province. Homesteaders mixed raw clay with straw to make bricks and stucco. Sometimes clay was used to create works of art. Small brick making factories scattered around the province supplied local building markets. Early industries such as those at Claybank, Estevan and Bruno

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<sup>8</sup> Saskatchewan Interactive, Bentonite.

<sup>9</sup> Ibid.

<sup>10</sup> Saskatchewan Interactive, "Mining: Industrial Minerals," Kaolin, University of Saskatchewan, [http://interactive.usask.ca/ski/mining/search/mineral\\_types/industrial/kaolin.html](http://interactive.usask.ca/ski/mining/search/mineral_types/industrial/kaolin.html)

<sup>11</sup> Ibid.

manufactured bricks, stoneware and earthenware pottery and fire brick products.

### *Claybank Brick Plant*

The clay of the Whitemud Formation of the Dirt Hills had been used by First Nations people for ceremonial, medicinal and utilitarian purposes for generations.<sup>12</sup> Its refractory properties were first discovered by Europeans in 1886, and the clay began to be hauled to Moose Jaw to be made into bricks.<sup>13</sup> The arrival of the railway made a local plant possible. Built in 1912, the plant, called Saskatchewan Clay Products and then Dominion Fire Brick and Pottery Company, processed refractory clay in the nearby Dirt Hills to produce brick for kilns and steam engine fireboxes, as well as face brick for buildings in Saskatchewan and across Canada, including the Chateau Frontenac in Quebec City, the Gravelbourg Cathedral, and many other public buildings in Saskatchewan.<sup>14</sup> Refractory brick was also used in foundries and smelters across the country. The fire bricks made by the company were also used in the construction of the launch pads at Cape Canaveral in Florida.<sup>15</sup> Claybank became Saskatchewan's largest brick producer, employing many local people. It closed in 1989 and became a National Historic Site in 1994.

### *Estevan Brick*

Clay suitable for brick making was found by early coal miners along the banks of the Souris River. By 1902, typical buff coloured brick was being manufactured by several small outfits in the Estevan area.<sup>16</sup> The Eureka Coal and Brick Company, later called International Clay Products, began making bricks about 1906 and supplied typical buff brick for such buildings as the sanitarium at Prince Albert, the Mental Hospital at North Battleford and the Estevan court house.<sup>17</sup> By 1927, the company was importing clay from Eastend for a new pottery plant. Purchased in 1945 by the Saskatchewan government and later privatized, the operation, by the beginning of the 1980s, was one of the most modern in Canada with 140 different products made from six types of Saskatchewan clay.<sup>18</sup> It sold over ten million bricks annually in Saskatchewan, Alberta, British Columbia, Manitoba, Ontario, Quebec and the United States and was the leading producer of white bricks in Canada.<sup>19</sup>

### *Bruno Clayworks*

The Bruno Clayworks was started about 1905 and operated until the 1960s when it closed down

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<sup>12</sup> W.G. Worcester, Clay Resources of Saskatchewan. (Regina: Thos. H. McConica, King's Printer, 1950),45.

<sup>13</sup> Claybank Brick Plant Historical Society, "Historical Overview Claybank Brick Plant," <http://www.sasktelwebsite.net/cbphm/Historical%20Overview.html>

<sup>14</sup> Claybank Brick Plant Historical Society, "Claybank Brick Plant National Historic Site," <http://www.sasktelwebsite.net/cbphm/>

<sup>15</sup> Ibid.

<sup>16</sup> Estevan Local History Committee, A Tale That is Told, "Estevan Brick Ltd." <http://cap.estevan.sk.ca/community/atalethatistold/index.html>

<sup>17</sup> Ibid.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.

due to competition with Saskatchewan Clay Products.<sup>20</sup> The Bruno Clayworks employed as many as 23 men in manufacturing hollow building tile, drain tile, farm tile, Roman tile bricks, common brick, and face brick.<sup>21</sup> Monthly capacity was as much as 450,000 face brick or 10,500 common brick.<sup>22</sup>

### *The University of Saskatchewan's Ceramic Department*

At the University of Saskatchewan, the government-sponsored Ceramic Department was founded in 1921 within the College of Engineering. Until 1951, when it closed, the department studied and tested Saskatchewan's clay resources and developed markets for them. Products researched and tested in its laboratories included firebrick, building tiles and hotel chinaware, and materials used in the glass and paper industries. Ceramic advertising pieces were produced and hundreds of paperweights, stamped "Made From Saskatchewan Clay", were given away by the university, the province and the Saskatoon Board of Trade. Vases and bowls were displayed at trade and crafts shows across the country to promote Saskatchewan clays.

### *Kaolin*

Kaolin has been studied in Saskatchewan for almost 50 years. It has been used for blending with plastic clays to increase refractoriness and reduce shrinkage during the drying process in brick production. As well its possible use as a filler for paper, paint, adhesives and caulking, kaolin can be used as a whitener for other clays, as kaolin fibres for high temperature ceramic wool insulation; porcelain, as a component in portland cement, as a filler in rubber, adhesives, and sealants; and for bone china, porcelain and wall and floor tiles.<sup>23</sup> Synthetic zeolites, molecular filters for water and other liquids, can be made with kaolin.<sup>24</sup>

Saskatchewan's kaolin reserves have been estimated at several hundred million tonnes. Since Canada imports all of its kaolin, 97% from the southern United States and 3% from England,<sup>25</sup> the potential for Saskatchewan is good. The paper industries of western Canada, western Ontario and the northwestern United States represent the best market.<sup>26</sup> With huge resources, shorter transportation routes, and expected continued growth in world demand, Saskatchewan is well placed for future harvesting of its kaolin deposits.

### *Bentonite*

Saskatchewan bentonite of the swelling type, recognized in the 1920s, began to be quarried in the

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<sup>20</sup> Michael J Hepp, *The Legacy of St. Peter's Colony*, "The Bruno Clayworks," <http://www.ourroots.ca/e/toc.aspx?id=6058>, 157-59.

<sup>21</sup> *Ibid*, 158.

<sup>22</sup> *Ibid*.

<sup>23</sup> Saskatchewan Interactive, *Clay*.

<sup>24</sup> Saskatchewan Interactive, *Kaolin*.

<sup>25</sup> *Ibid*.

<sup>26</sup> *Ibid*.

Truax area in 1970. In 1978 the Canadian Clay Products processing plant was established at Wilcox. Bentonite swells tremendously and forms a thick gel when moisturized and is used in many ways. Perhaps its major use is in the oil and gas drilling industries where it is combined with water to create a jelly like lubricant during well drilling, cooling the bit, keeping the drilling fluid in the bore and allowing cutting particles to float to the surface.<sup>27</sup> At the same time, the mud helps to keep the borehole walls intact. Bentonite is also important as a binder for animal feed, for foundry sand and for iron ore.<sup>28</sup> It is used as a natural soil sealant in reservoirs, lagoons and mining ponds and is a component in many water purification processes. It is a plasticizer in ceramics, stucco and mortar and it has potential as a carrier for insecticides and pesticides.<sup>29</sup> It is even used as cat litter.<sup>30</sup> Saskatchewan sodium bentonite is sold mainly in western Canada, but also makes its way as far east as Quebec. Wyoming and Greece are our major competitors. The non-swelling variety of bentonite is also used in foundry processes. It is commonly used as a decolourant, an absorbant material for oils and as a binder. Reserves of bentonite are estimated to be eight to 10 million tonnes.<sup>31</sup>

### *Ceramic Clays*

Ceramic clays in Saskatchewan are usually kaolin types from the Whitemud Formation. Other types are also used in ceramic production. Most production concentrates on facing brick for the Canadian and United States market and stoneware clay which supplies the Canadian market. Saskatchewan clay is quarried by two Alberta companies for common and facing brick and for pottery and stoneware clay. Chimney flue liners, sewer pipes, fire brick and pottery have been produced at Estevan and Regina

### *Other Products*

Both bentonites and local glacial clays are used in place of gravel in concrete products at Regina and in lightweight aggregate production in Regina and Saskatoon.

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<sup>27</sup> Saskatchewan Interactive, [Bentonite](#).

<sup>28</sup> Ibid.

<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

<sup>31</sup> Ibid.