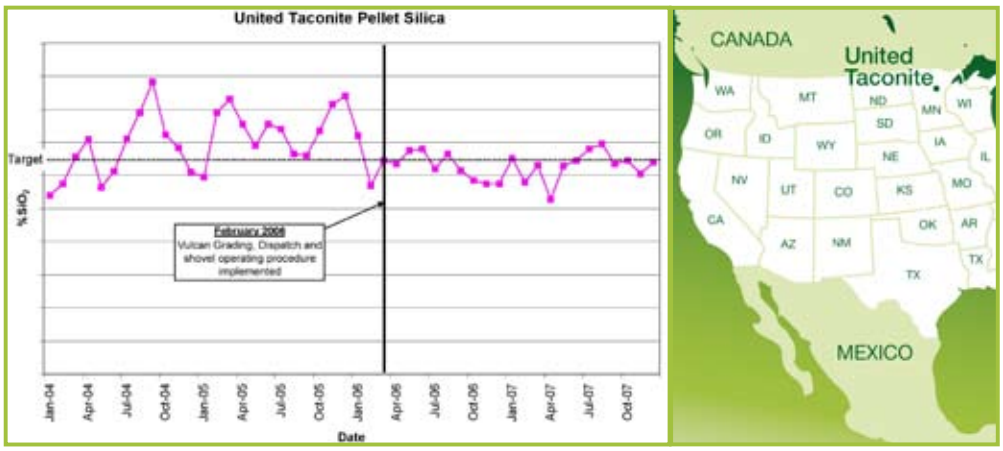
MAPTEK™ Vulcan™

CASE STUDY

Cleveland-Cliffs improves ore grading accuracy

Cleveland-Cliffs Inc. is the largest producer of iron ore pellets in North America and a major supplier of metallurgical coal to the global steelmaking industry. Cliffs operates iron ore mines on the Marquette Iron Range in Michigan, and the Mesabi Iron Range in Northern Minnesota.



More consistent silica has resulted from applying Vulcan to ore grading

HIGHLIGHTS

- Vulcan has been used at United Taconite since 2003
- Ore grading using Vulcan has increased the consistency of crude oil blend
- More than 90% of crude ore sent to concentrator now meets quality targets

United Taconite, one of the Cliffs-operated mines on the Mesabi Iron Range, mines taconite, a low grade form of iron ore containing approximately 27-35% magnetite.

Using crushing, grinding, magnetic separation, and agglomeration techniques, a 60% iron pellet is produced. Contracts with the steel mills set the quality standards of the pellet composition.

Maptek Vulcan™ mine planning software has been used at United Taconite since 2003, to ensure a consistent, predictable crude ore blend is sent to the concentrator.

More specifically, ore grading using Vulcan, coupled with dispatch software and shovel operating procedures, has increased the consistency of the crude ore blend to the concentrator to produce predictable pellet quality.

After a blast is planned and shot, it is then graded using Vulcan. Two of the assay values evaluated to classify ore are Davis Tube concentrate silica and crude magnetic iron content which are limited by maximum and minimum values, respectively.

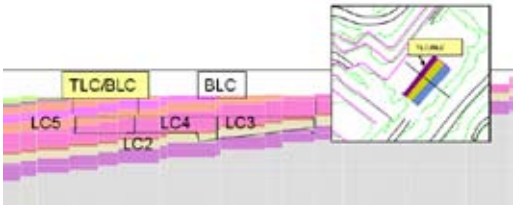
> Vulcan is used in every phase of mining including block modelling, mine planning, blasting and ore grading.

As blasts are graded, they are divided into regions that take into account these values as well as lithological composition.

Ore is mined from 2 separate horizons of the Biwabik Iron Formation; the Lower Cherty and the Upper Cherty. Ore types are grouped into 3 main geological categories (UC, TLC and BLC) based on lithology, and characterised by differing silica contents.

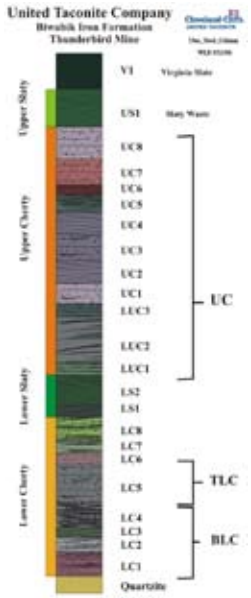
Blending from 3 shovel locations allows for the moderation of variables present in the ore and for each of the 3 main geological categories to be present in the blend.

The TLC/BLC position is composed of 2 very different subunits of the Lower Cherty. If the dig location were split in half, each of the 2 new blocks would contain a majority of 1 type of material.



Relationship between the in-situ triangulations and the polygons

Mining profile



Ore is mined from 2 separate horizons of the Biwabik Iron Formation; the Lower Cherty and the Upper Cherty

Face width is taken into consideration to allow a shovel to productively dig from a particular location. Ore is graded on a 6,000 ton running average to best simulate the grade of a train load of ore.

The in-situ ore grade for each dig location is calculated in Vulcan using a solid triangulation. Polygons are drawn around these triangulations to represent the dig location, while taking blast throw into account.

These polygons are linked to block model information for their respective defined triangulations. Field observations can be incorporated into the position of the dig location boundaries.

Block model assay value estimates are averaged in Vulcan to represent a dig location as one homogeneous dig location. This assumption is viable only if the dig location is mined evenly across the face perpendicular to strike.

Not only are these blocks very different from each other in lithology and grade, but they differ greatly from the combined original dig location.

If a physical reason forces an original block to be taken as 2 blocks, Vulcan software allows adjustments. This flexibility in grading provides increased accuracy based on a variety of field observations.

In addition, assay values can be changed in the dispatch software based on magnetic susceptibility readings taken at the crusher, and on laboratory data.

Since implementation of the grading, dispatch, and shovel procedures in early 2006, 90% of crude ore delivered to the concentrator is within +/- 0.5% of the Davis Tube concentrate silica target.

In contrast, only 60% of crude ore delivered before the implementation of this ore grading procedure was within the target limits.

The stabilisation of crude ore grade delivered to the concentrator is directly responsible for lowering the pellet silica variability.