Kimberlite Indicator Minerals

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Created by:
Fred Swanson, Consulting Geologist, R.R. 1, Highland Grove, ON K0L 2A0
Lynn Kelley, while with Saskatchewan Geological Survey, Saskatchewan Ministry of Energy and Resources, Regina, SK S4P 3V7

Database Availability
For a copy of the latest database in Microsoft Access format contact:
Jason Berenyi
306-787-2579
jason.berenyi@gov.sk.ca

Abstract

More than 27,000 microprobe analyses of heavy mineral grains from over 1,600 discrete sampling sites are recorded in this database, which has been compiled from 10 public-sector surveys. With each sample site representing an average of about 500 square kilometres, the data is not sufficiently dense for detailed exploration, but can be used to provide regional context for more detailed private-sector efforts. The data can be searched by geographic parameters and mineralogical or chemical discriminators. Search results can be exported to a comma-separated values (CSV) file, which the user can import into most commonly available spreadsheet, database or geographic information system (GIS) programs. Results can also be exported directly in Microsoft Excel format.

Introduction

Diamondiferous kimberlites were discovered at Sturgeon Lake, Saskatchewan in 1988. Intense exploration for diamonds ensued and dominated the province's exploration scene for the next few years. One of the exploration techniques widely used in Canada, and other recently glaciated areas, is the "indicator-mineral" survey. The principal is simple. Most of Canada has been glaciated. As glaciers advance, they erode, homogenize and re-distribute the components of the bedrock that they pass over. If tracers of diamondiferous kimberlite are found in the re-distributed glacial material, their bedrock source must lie in the up-ice (analogous to upstream) direction.

Diamonds in glacial drift are the most direct indicators of a bedrock source of diamond. However, diamonds are rare even in the highest-grade diamond-bearing rocks, and one carat (0.2 g) of diamond per tonne of ore is considered a very high-grade diamond deposit. Certain other mantle-derived minerals with a specific range of chemical compositions, including garnet, diopside, and chromite are found in diamond-bearing rock, but are typically thousands of times more abundant than the diamonds themselves. These indicator minerals are then an indirect, but more efficient tool for locating bedrock sources of diamond.

Large samples (typically 10 to 20 kg) of glacial or glaciofluvial sediment are collected at each sample station. The sample is reduced through washing and sieving. The sand-sized fraction is further reduced through dense-media-separation. The indicator minerals are more dense than most of the minerals in the sample. The reduced sample is immersed in liquid that has a specific gravity in excess of 3.0. The heavy minerals, including the indicator minerals sink through the dense media, while the less dense minerals and rock fragments float and are discarded. The indicator minerals are non-magnetic, so the sample is further reduced through the use of a high-intensity magnet to separate the magnetic and non-magnetic minerals. The non-magnetic grains are examined under a binocular microscope. Selected grains are prepared for chemical analysis by electron microprobe.

The database compiled here is an archive of sample field data and chemical analyses for all currently available kimberlite-indicator mineral surveys carried out in Saskatchewan by public agencies, including the Saskatchewan Geological Survey, the Geological Survey of Canada, and the Saskatchewan Research Council (Simpson, 1991; Gent, 1992; Swanson and Gent, 1993; Thorleifson and Garrett, 1993; Millard, 1994; Millard and Drever, 1994; Swanson and Gent, 1994; Thorleifson et al., 1994; Millard and Day, 1996; Swanson, 1996 Swanson and Smith, 1998). The two Geological Survey of Canada reports included samples from Manitoba and Alberta. These extra-provincial samples have not been culled from the dataset. The geographic distribution of the sample sites is shown in Figure 1 of the PDF document attached below.

The compiled database can be searched by geographic parameters and mineralogical or chemical discriminators, as described below. Search results can be exported to a comma-separated values (CSV) file, which the user can import into most commonly available spreadsheet, database or geographic information system (GIS) programs.

The first line of the CSV file consists of headers that describe the data. Most of the headers are self-explanatory, except for the mineral name. Not all of the surveys, as originally published, contained mineral names for each species. All of the chemical data was processed using the program developed by (Gent, 1993) to assign mineral names based on chemical composition. Gent's program is modeled on the work of Dawson and Stephens (Dawson and Stephens, 1975; 1976; Stephens and Dawson, 1977)

Cautions for the User

1. This database is a compilation of similar work by many individuals. The media sampled, sample size, methods for reducing the samples, indicator-mineral picking criteria and analytical techniques are generally similar among the various surveys compiled here, but the user is advised to compare in detail the methodologies described in the original reports. It is apparent in comparing the 10 data sets compiled in this database that the criteria for picking indicator grains for microprobe analysis varies widely amongst individual microscopists.
2. The concept that mineral chemistry can be correlated with diamond potential of kimberlite is a concept that was developed for mineral grains derived from kimberlite. The provenance of so-called indicator minerals separated from sediments or sedimentary rocks is problematic, as pointed out by Schulze (1993). Indeed, many of the garnets included in the compiled database are crustal garnets.
3. The authors of the original surveys that are compiled here recorded sample locations in a variety of ways, including recording an estimated position by landmarking on a topographic map and by GPS. Locations from either method were recorded in degrees of latitude and longitude or UTM coordinates referenced to either NAD 27 or NAD 83. The sample locations fall in UTM zones 12, 13 and 14. All locations have been converted to the NAD 27 datum, extended zone 13.

It will be simplest for the user to search for data using extended zone 13 co-ordinates and to plot the sample stations on a map that is referenced to extended zone 13. However, considering the variety of formats in which sample locations were recorded and the various conversions required to harmonize the data, positional accuracy has probably been compromised.

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