



DIAMONDS

Diamond is one of the two crystalline forms of the element carbon (C). The other is graphite. Diamond is the hardest known naturally occurring substance (mineral) and ranks as No. 10 on Moh's hardness scale. It is about five times harder than corundum (ruby or sapphire), the next hardest material. Although a diamond is hard, it is very brittle and will shatter with a sharp blow, breaking parallel to cleavage planes. Diamond crystallizes in a cubic form, has a specific gravity of 3.5, and is colorless. Imperfections may produce tints of yellow, pink, blue, brown, and black (Figure 1).

Because of its high thermal conductivity, a diamond is cold to the touch and can be heated red hot then plunged into liquid nitrogen without harm. This thermal property, along with diamond's hardness and abrasion resistance, makes it important as a cutting and polishing medium.

The standard weight of a diamond is expressed in metric carats; a carat is one-fifth of a gram. As a gemstone, it is very valuable and may weigh less than a penny, but be worth a small fortune. The largest gem quality diamond ever found weighed only 1.5 pounds (3106 carats) and was about the size of a man's fist. Typically, most diamonds are smaller than a garden pea.



Figure 1. The "Dewey Diamond", Manchester (now a part of the City of Richmond), Chesterfield County (photograph courtesy of the Smithsonian Institution).

DIAMOND FACETING

In cutting diamond, early gem cutters utilized cleavage by grinding one rough diamond against another to remove "skins" and give the stone its shape. This allowed the dispersion of light within the stone into the colors of the spectrum, which revealed its fire and beauty. The 58-facet brilliant cut was developed before 1700. Early in the 20th Century, cutters learned how to angle the facets so that when light enters the top of a diamond, it is reflected inside and back to the top of the stone to produce maximum brilliance and fire. To reduce waste, some diamonds are cut too deep or too flat to produce maximum brilliance, and gems of top quality are not produced. Various diamond cuts, other than brilliant, include marquise, oval, emerald, pear, heart shape, and baquette.

INDUSTRIAL DIAMONDS

In 1955, the production of "synthetic" diamonds (in the form of "grit") became a reality; by 1993, more than 116 million carats of natural and synthetic diamonds were produced in the United States. Industrial grade natural diamonds are diamonds that are off-color, flawed, broken and are not suitable as gem material. Seventy-five percent of all natural diamonds produced are industrial grade. Major uses for industrial diamonds (both natural and synthetic) are for abrasives in the production of machinery, in mineral services (drilling), and for cutting and finishing stone and ceramic products. Reused diamond includes diamond grit and powder salvaged from diamond grinding wheels and saws and stones recovered from broken or worn diamond tools and drilling bits.

SOURCE OF DIAMONDS

There are three main sources of diamonds: kimberlites, lamprophyres (mafic to ultramafic igneous rocks), and alluvial or placer deposits derived from weathering of these igneous rocks. Kimberlites, a primary source of diamonds, are derived from the melting of rocks that compose the earth's mantle. They are usually dark green in color and composed mainly of the silicate minerals olivine, serpentine, mica, and some pyroxene. Kimberlites also contain calcite and iron-titanium oxide minerals and they are found in geologic settings where the earth has been tectonically

inactive for millions of years (Pasteris, 1983). During exploration in the Northwest Territories of Canada in the late 1970s, garnets, chromite, and other indicator minerals with slightly different chemical signatures were determined to be present in diamond-bearing kimberlites but absent in barren kimberlites. These minerals included G10 garnets, which are lower in calcium (under 4 percent) and higher in chromium than other garnets and diamond-inclusion chromite which is higher in chrome (62.5 percent or more) than other chromites. When iron in ilmenite was highly oxidized, a kimberlite contained virtually no diamonds. It was determined that iron took on more or less oxygen in response to heat and available oxygen in the magma. When iron became highly oxidized, so did the diamonds, essentially vaporizing into carbon dioxide. As a result, G10 garnets and chromite determine how many diamonds entered the kimberlite and the ilmenite

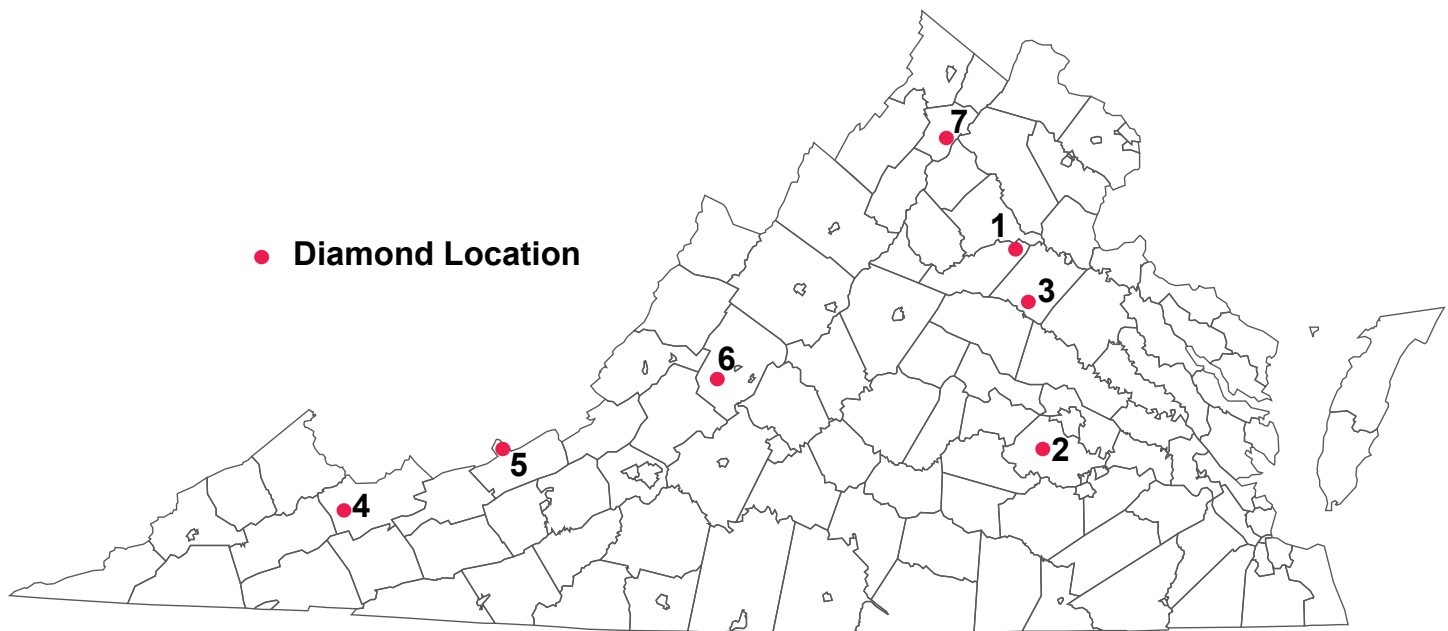


Figure 2. Diamond finds and potential exploration sites in and near Virginia. 1. Vacluse Mine; 2. “Dewey Diamond”; 3. Whitehall mine; 4. Tazewell County; 5. “Punch Jones” Diamond; 6. Mount Herob kimberlite; 7. Front Royal peridotite.

determines how many survived (Sweet, 1997). Kimberlite is produced when peridotite (dark intrusive rock composed mainly of olivine with pyroxene) melts at different levels in the earth’s upper mantle. Initial melting may occur at depths of 150-200 km where temperatures are over 800°C and pressures are greater than one million pounds per square inch. The peridotite melt is practically a liquid and allows carbon atoms to freely move around. Dating of zircons included in diamonds provides a Precambrian age (older than 550 million years) which indicates that the diamonds have been preserved in the mantle for a very long time.

Major diamond deposits occur in “pipes” or diatremes that branch toward the surface (Pasteris, 1983). A diatreme may consist of several intrusions of kimberlite and may have erupted like a volcano. As the kimberlite melt rises, it captures fragments of surrounding rocks, which are carried along with the intrusive. Crystallization takes place toward the surface which changes the chemistry of the melt and the end product may be entirely different from the composition of the original melt in the mantle. Although kimberlites are the main source rock for diamonds, only about 5 percent of known kimberlites contain diamonds. The richest kimberlites thus far discovered contain about 20-30 carats of diamonds per 100 tons of rock.

Other diamond sources include mafic and ultramafic rocks, such as lamprophyres which occur in the belt of rocks from Alabama to eastern Canada. Gravels suspected of being derived from these rocks have yielded diamonds in Virginia and several other eastern states (Wilson, 1948). The specific source of the diamonds is speculative. A third source is the placer or alluvial occurrence, where it may be difficult to trace a given deposit to its bedrock source. However, it is assumed that the placer or gravel deposits were deposited by streams that drain regions where diamond-bearing rocks occur.

DIAMONDS IN VIRGINIA

Five sites in or near Virginia where diamonds are reported to have been found, one peridotite site and one kimberlite site are shown on Figure 2. Sites include the Vacluse mine; “Dewey Diamond”, Manchester; Tazewell County area; “Punch” Jones Diamond, Peterstown, WV.; Mount Horeb kimberlite; Whitehall mine, and the Front Royal peridotite.

VAUCLUSE MINE

In eastern Orange County, north of the end of State Road 667, is the site of the abandoned Vacluse gold mine where a “diamond of the first water” was reported to have been found in gold washings in 1836 (Anonymous, 1847). In 1847, the diamond reportedly remained in the possession of the proprietors of the mine, Thomas H. Boswell and William H. White (Sweet, 1997).

DEWEY DIAMOND - MANCHESTER

The “Dewey Diamond” was found at the southwestern corner of Ninth and Perry streets in Manchester (now a part of the City of Richmond) by Benjamin Moore, a laborer. Mr. Moore was leveling a hill at this location in 1854 and found the diamond in the soil (Green, 1982).

The diamond was sold to a jeweler in Richmond and then to Captain Samuel W. Dewey, a geologist and mineralogist from Philadelphia for \$1500. The first account of the diamond was published in the April 18, 1855 issue of the “New York Evening Post”, where it was called the “Dewey Diamond” after Captain Dewey and was described as the “largest diamond found in North America.” Dietrich (1990) states that the diamond was also referred to as the “Manchester” diamond. As noted by Kunz (1890), the diamond was described by John H. Tyler as having a large flaw on one side and was an octahedron with slightly rounded faces. In 1855, Dewey, attempting to eliminate the imperfection, had the diamond cut in New York City, which

reduced its size from the original weight of 23 3/4 carats to 11.15 carats. Later, the diamond was sold to John Morrissey, a prize fighter, for \$6000. He, as the last owner of the diamond on public record, died in the late 19th Century.

WHITEHALL MINE

Stephenson (1878) notes that Mr. Featherstonhaugh, an English geologist, found a diamond at the Whitehall gold mine in west-central Spotsylvania County, north of State Road 608.

TAZEWELL COUNTY

In 1913, a diamond was found by Frank Brewster, a laborer, in a cornfield, 200 feet above a local stream bed, on the farm of J. S. Gillespie near Pounding Mill, Tazewell County. Mr. Brewster sold the stone to H. W. Pobst, a jeweler in Tazewell, Virginia, who had it cut by J. R. Wood and Sons of New York. H. W. Pobst's son, Tom, said that the stone was a beautiful blue color and also noted that Wood had declared it to be a genuine diamond. The diamond, now cut to 0.83 carat, has been set in a ring. Today the ring remains in the Gillespie family (Sweet, 1997). According to Holden (1944) no more stones have been found at this site in the following 30 years of searching.

“PUNCH” JONES DIAMOND

In April, 1928, a diamond that was even larger than the Dewey Diamond was discovered. This diamond known as the “Punch” Jones Diamond was found along Rich Creek, Peterstown, West Virginia, less than 1 mile from the Virginia state line. It is believed that the diamond was actually from a source in Virginia and washed down Rich Creek into West Virginia. It measured 5/8 inch across with 12 diamond-shaped faces, weighed 34.48 carats, and was the largest found in North America at the time of its discovery.

The bluish-white diamond was found by William P. “Punch” Jones and Grover C. Jones, Sr., while pitching horseshoes, in their yard in April, 1928. In 1942, “Punch” Jones, then 26 years old, asked his father about the stone that they had found fourteen years earlier. It had been stored in a wooden cigar box, stashed in a tool shed. After “Punch” convinced himself the diamond was genuine, he contacted Roy Holden, a geology professor at Virginia Polytechnic Institute and State University in Blacksburg. After Holden authenticated the diamond, it was sent to the Smithsonian Institution by Jones for safekeeping and remained there until early 1964. Punch Jones was killed in World War II and possession of the stone was passed to his father. In February, 1964, the Jones' brought the diamond home and put it in a bank deposit box in the First Valley National Bank in Rich Creek, West Virginia.

When Grover Jones died in 1976, his widow (Grace) and grandson Robert became owners of the diamond. In 1984, Robert sold the diamond through Sotheby's auction house in New York to an agent representing a lawyer in the Orient for \$74,250. Grace Jones passed away in 1992 (Sweet, 1997).

MOUNT HOREB KIMBERLITE

A kimberlite occurs near Mt. Horeb Church in western Rockbridge County. At the surface, the kimberlite consists of three separate intrusions into an Ordovician age carbonate

sequence (Sears and Gilbert, 1976). Sears and Gilbert (1973) note that unaltered primary crystals in the kimberlite include chrome-rich spinel, green clinopyroxene, pyrope garnet, ilmenite, rutile, zircon, and amphibole. Altered material consists of montmorillonite, vermiculite, and chlorite. Xenolithic fragments of Middle Ordovician sandstone and fossiliferous limestone are also present.

According to Sears and Gilbert (1973) the chemistry is sufficient to verify the body as a kimberlite and thus establish its mantle origin. However, Gilbert (1982, written communication) notes that because spinel is more abundant than garnet, that a shallower depth of origin (50 to 100 km versus 150 to 200 km) seems likely. The body may be more aptly a spinel peridotite than a garnet peridotite. Some exploration was done in the early and late 1980s on sites of two of the intrusions that are presently owned by two separate landowners. No diamonds have been found at either of these sites.

In the fall of 1995, the Virginia Division of Mineral Resources drilled several auger holes off the northeastern side of State Road 807 (Pullen Road) and on the southwest slope of the kimberlite. The most successful hole was spudded at 1510 feet elevation in weathered kimberlite and was drilled to a depth of 34 feet; total depth remained in weathered kimberlite (Sweet, 1997).

FRONT ROYAL PERIDOTITE

A mica peridotite dike (600 ft x 150 ft) occurs in Warren County, 4.5 miles west of Front Royal, off the northwest side of State Road 626, approximately 0.35 mile by road northeast of its intersection with State Road 617. Thin section analyses by Young and Bailey (1955) identified the following minerals: chlorite, 43 percent; phlogopite, 31 percent; hydrobiotite (?) pseudomorphs after olivine and pyroxene, 13 percent; secondary pyrite, 5 percent; perovskite, partly altered to leucosene, 4 percent; apatite, 2 percent; dolomite, 1 percent; and ilmenite, magnetite, and epidote, less than 1 percent.

The dike, which has been chloritized, was examined by Rader and Biggs (1976). They made two magnetic traverses across the dike with a GeoMetrics model G-806 portable magnetometer. The traverses show a magnetic zone in the body about 6 feet thick. Weathered samples were obtained from three pits dug in the eastern most, central, and western most portions of the dike. X-ray analyses by the Division of Mineral Resources note the following minerals: ankerite, calcite, chlorite, clays, garnet (andradite), magnetite, phlogopite, pyrite, quartz, rutile, serpentine, and talc. Ten soil samples along two traverses were analyzed by atomic absorption and indicated significant peaks for chromium (300-400 ppm) and nickel (300-550 ppm) in both traverses (Rader and Biggs, 1976).

Southworth and others (1993) have described the dike as a mica peridotite similar to dated Late Jurassic dikes in the Appalachians and they indicate the dike to be a kimberlite. At the present time, only scattered pieces of the dike rock are present on the site, which extends across properties owned by several different landowners.

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