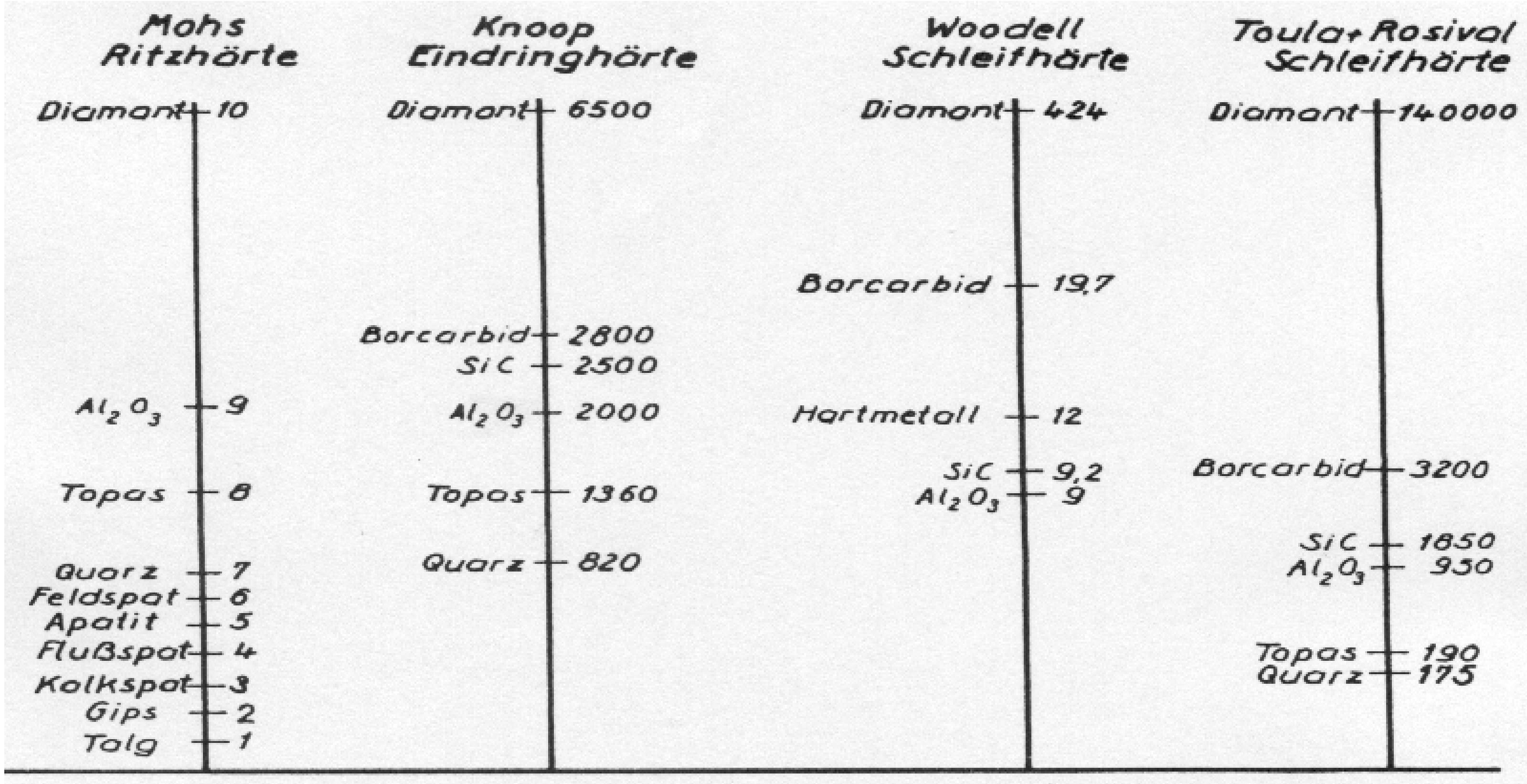
INDIMANT

Diamond and its characteristics

Stand 12.06.2012

The hardness of the diamond



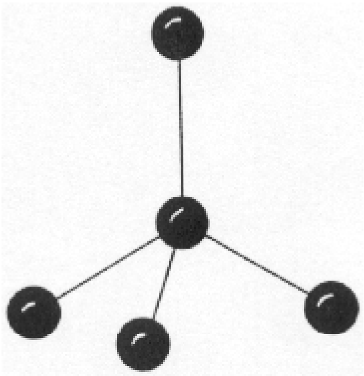
The word “diamond” stems from the Greek word “adamas” which translates impregnable or indomitable. It hints at the enormous hardness of diamonds, the hardest of all jewels and even of all substances as you can see in the table. In spite of its hardness, diamonds are brittle and very delicate when used as a tool.

The Kimberley Mine (The “Big Hole”)

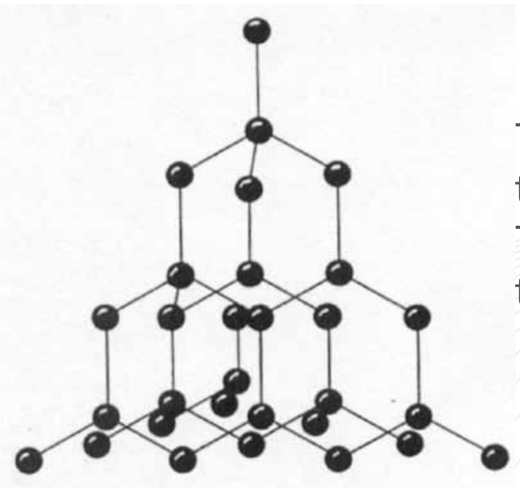
Within the more than 2,000 years of its exploitation, the mine delivered just 130 tons of diamonds. Since diamond-containing rock features only an average of 1/20,000,000 in diamonds, some 3 billion tons of rock, sand and boulders had to be processed in the Kimberley Mine – 1.8 tons for a single ct.

Diameter of the surface: 460 m
Depth: 400 m
Depth of mine shaft: 1,070 m

Tetrahedral configuration and alliance / formation of carbon atom



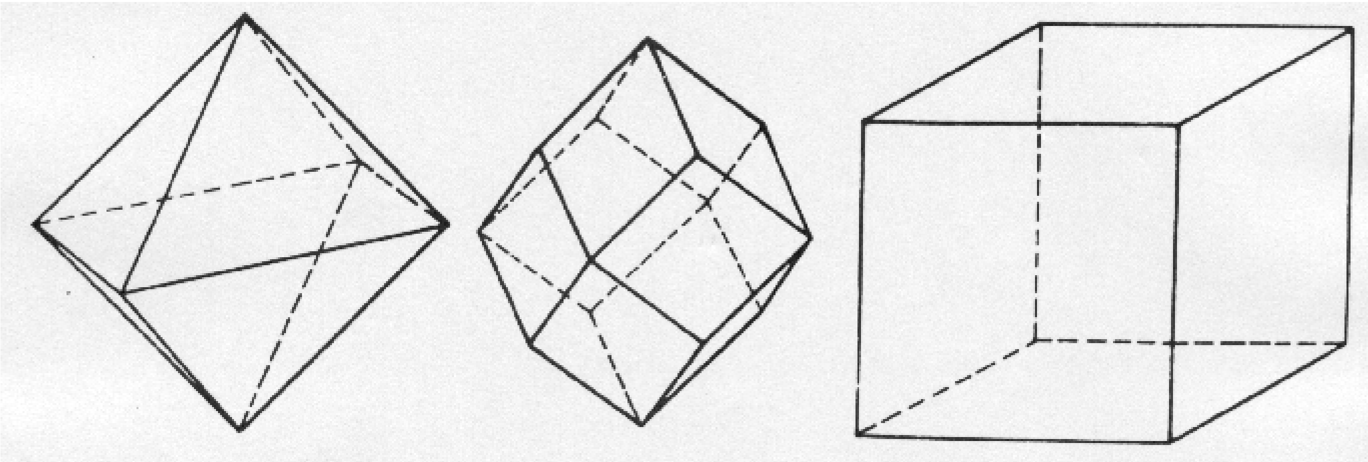
Diamond is made of pure carbon (c), same as soot.
This means that burned toast chemically equals diamond. The special feature of diamond is the tetrahedral formation of its carbon atoms. Every C atom is connected with four neighbor atoms by a covalent chemical binding.



The hardness of the diamond is caused by the strong chemical binding of the carbon atoms among each other.
The specific diamond structure is due to the carbon tetrahedral which is the smallest assembly alternately located in space.

Graphic exposition of crystal forms

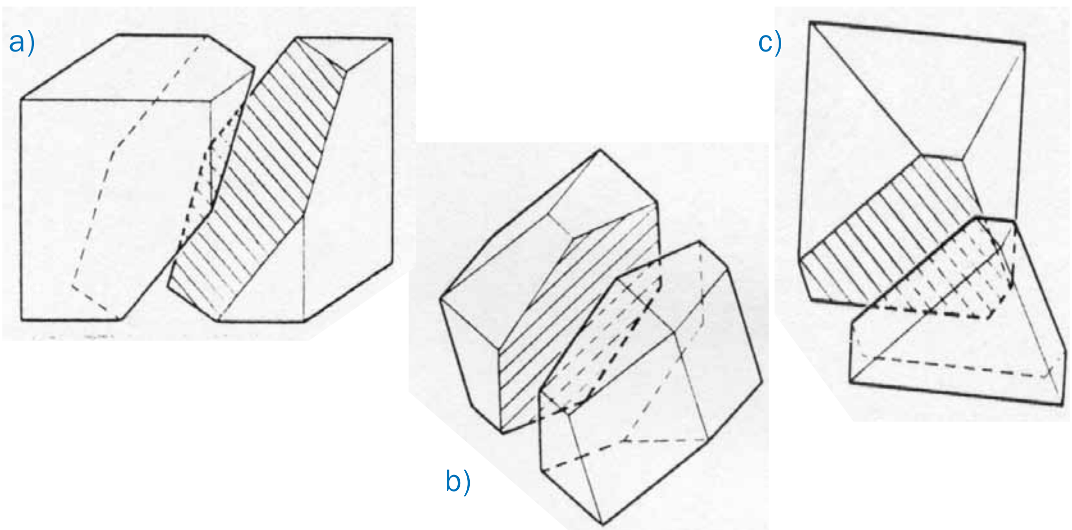
Diamonds exist in different forms; the most popular forms are the octahedron and rhombic dodecahedron (about 50% of all crystals). The cube is rare and most of the time imperfectly constructed.



Octahedron rhombic dodecahedron cube

Position of the cleavage plane

Due to the cleavage property of diamond the diamond breaks up at certain congeneric, parallel chemical bindings. In all other directions the diamond breaks out in a shell-like pattern, the same way as glass does.
The objective is to cleave the diamond similar to the splitting of wood.
As everyone knows, wool can be splinted only in the direction of its grain. Branches in the wood stop the splitting or mislead the direction. The same occurs to the diamond. Local failures of the structure – so-called Naatz – will mislead the cleaving plane, and might lead to uncontrolled dunting. While branches can be visually detected in wood, local failures of the diamonds are not recognizable, due to their miniature structure.

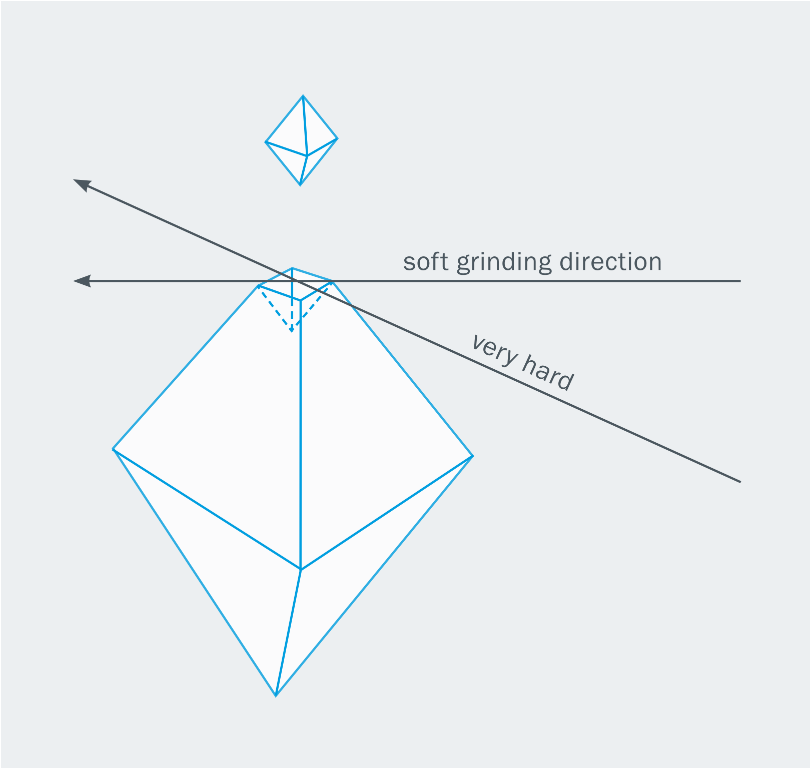


Position of cleaving plane (a), cube (b), rhombic dodecahedron and c) octahedron.

During production and the use of diamond tools, one has to observe that there may be cleaving planes with a minor mechanical capability of resistance.

For a wooden board it's obvious that there is no sense in having the longitudinal direction across the grain. The production of diamond tools follows the same insight.

Change of resistance of grade cutting on top of the cone point of an octahedral (same applies to cube level)



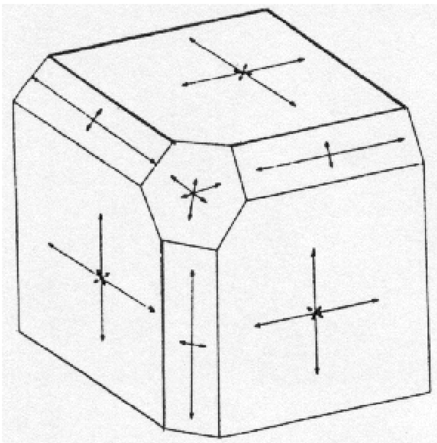
If you look at a diamond's grinding directions you will notice that the grinding hardness depends on the direction, as shown in this simplified graph.

Grinding directions

The only way to grind diamond is with a diamond.

When a grinding wheel is prepared with diamond dust, a certain amount of diamond particles will face the grinding direction of the tool that is to be grinded. This means in fact that something “soft” can be grinded by something which is hard.

Trying to grind the tool with its hard side with the diamond dust, nothing or little will happen due to the fact that there is nothing on the grinding wheel which is harder. “Soft directions” are meant relatively, of course, because even the soft directions are so hard that only a diamond can cause an effect.



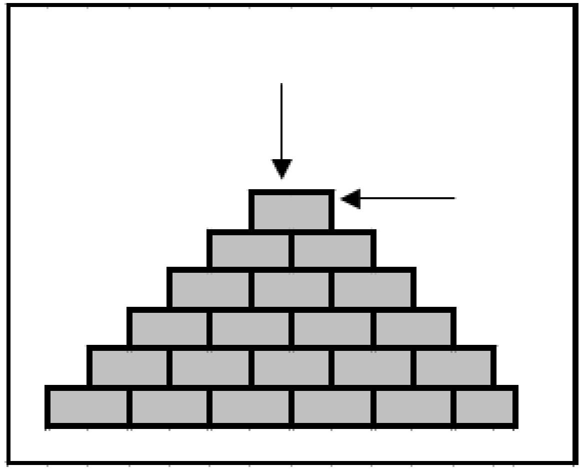
Grinding directions (the shorter the arrow, the greater the grinding hardness of that direction)

Variation of natural diamond shapes

Even if you are aware of these principles, it has to be mentioned that all this information is based on optimum shapes of the crystalline.
Experience shows that natural diamonds are crystalline individuals which exist in a variety of shapes, some of them rather distorted. The principles of grinding directions may be completely different when the geometry is changed by only 1° or 2°.
The picture shows the variety of natural diamonds.

Graphic demonstration of applied load directions.

In concluding, we want to clearly state that although diamond is the hardest material in the world, uncontrolled handling will make it as brittle as glass and therefore easy to damage, as the picture shows.



A stone pyramid structure only retains its shape because the weight of the stone blocks stabilizes the construction by applying pressure to the substructure. The structure cannot be damaged by forces applied from above. However, relatively little effort is required to move the stone blocks sideways.

During mechanical engraving work, force is primarily applied to the tip of the stylus (i.e. the tip of the pyramid) and is therefore able to withstand the load. If, however, you touch the cutting edge of the diamond with your fingers, there is always uncontrolled pressure on a “less stable pyramid face’” and parts of the cutting edge break away.

Attempts to clean with compressed air are just as dangerous for the stylus. If a particle of abrasive grit or dust strikes the cutting edge of the stylus at great speed, it will destroy the cutting edge.