Diamond: The King of Gemstones

Why diamond is King

- Diamond is the hardest natural substance
- It has adamantine luster and takes a very high polish
- Diamond has very high dispersion and breaks light into many colors creating fire
- Diamond is very transparent and this allows it to have high brilliance along with the fire
- Diamonds of highest quality are relatively rare and thus demand a high price
- Diamonds of modest gem quality are not rare, so there is a goodly supply!

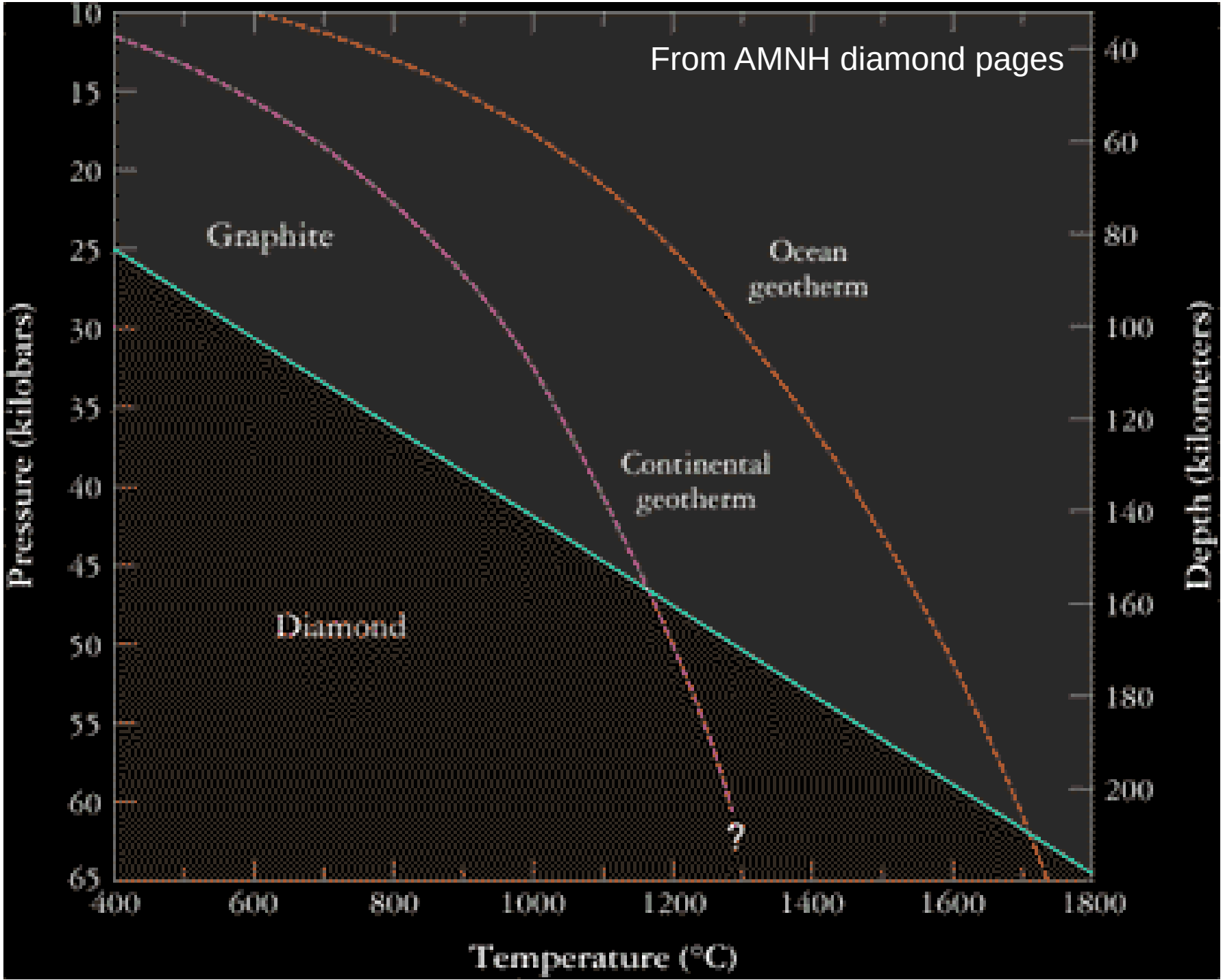
Where Do Diamonds Come From?

- All evidence points to diamonds forming at high temperatures and pressures within the Earth's mantle

- Most diamonds are carried from great depths to the surface in a volcanic rock. This rock is Kimberlite and it may form at depths of 300-200 KM (186.3 -120 mi)

Data about formation of Diamonds

- Studies of minerals associated with and found inside of diamonds and HTHP synthetic growth pressures of around 60,000 times greater than at the surface and temps above 1000°C.
- Kimberlite magmas are rich in carbon dioxide and water which brings the magma quickly and violently to the surface.


From AMNH diamond pages
Graphite
Ocean geotherm
Continental geotherm
Diamond
?
Pressure (kilobars)
Depth (kilometers)
Temperature (°C)
10
15
20
25
30
35
40
45
50
55
60
65
40
60
80
100
120
140
160
180
200
400
600
800
1000
1200
1400
1600
1800

Where are diamonds found?

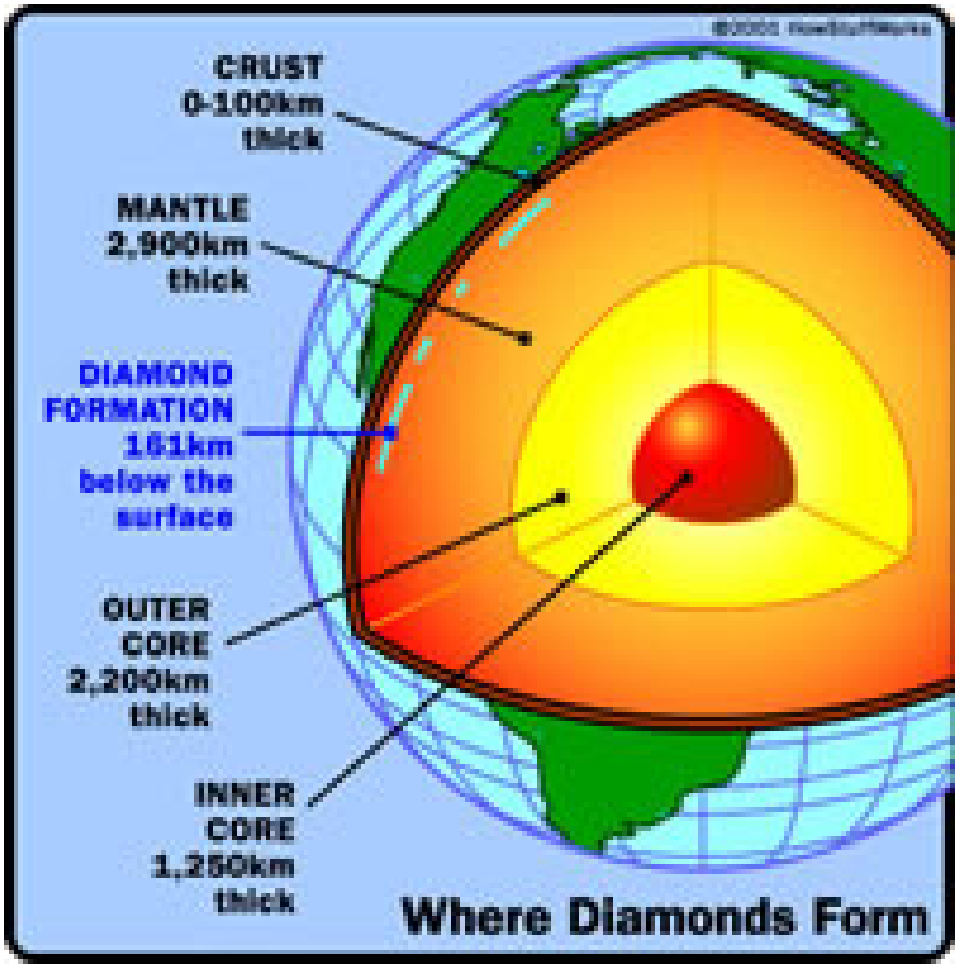
- Diamonds are found in 3 types of deposits:

➢ 1) Primary deposits in igneous rocks

➢ 2) Alluvial deposits in streams or ancient stream beds (also glacial deposits)

➢ 3) Oceanic deposits washed from land into the ocean

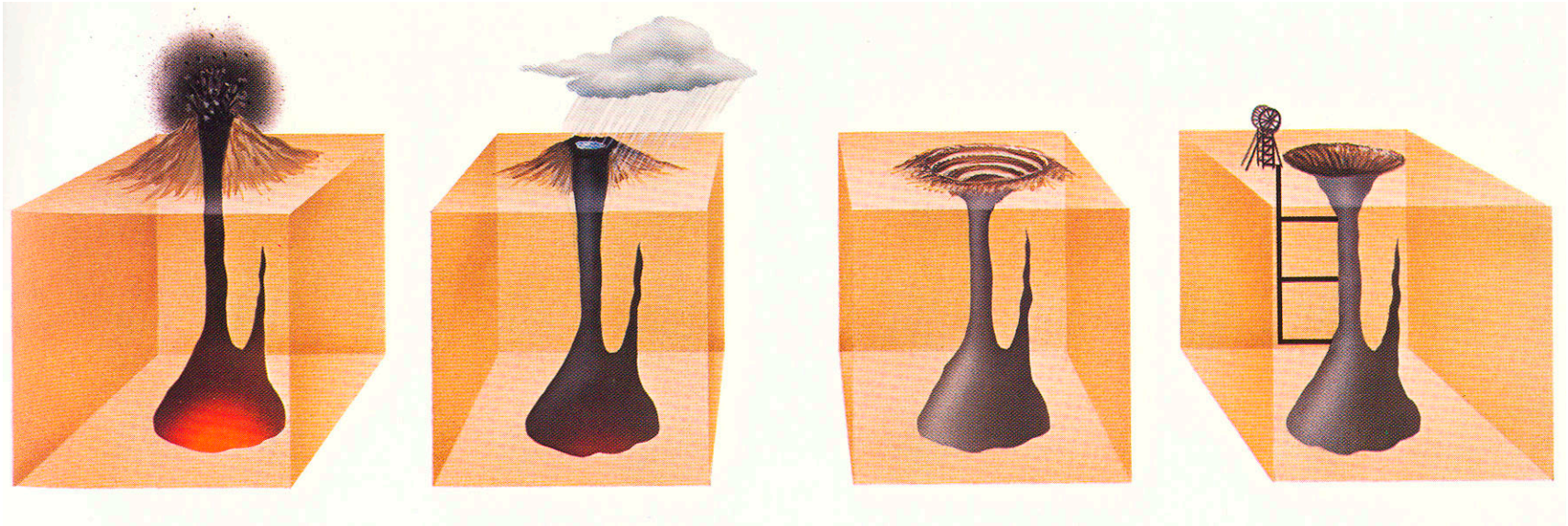
Where Do Diamonds Come From? (cont…)



- Diamonds form below the crust
- They are brought to the surface by volcanism.
- Once reaching the surface diamonds are durable and do not easily break down

An eruption carrying diamonds from the mantle reaches the surface

- Stages in the formation of a kimberlite pipe



1) Eruption

2) early weathering

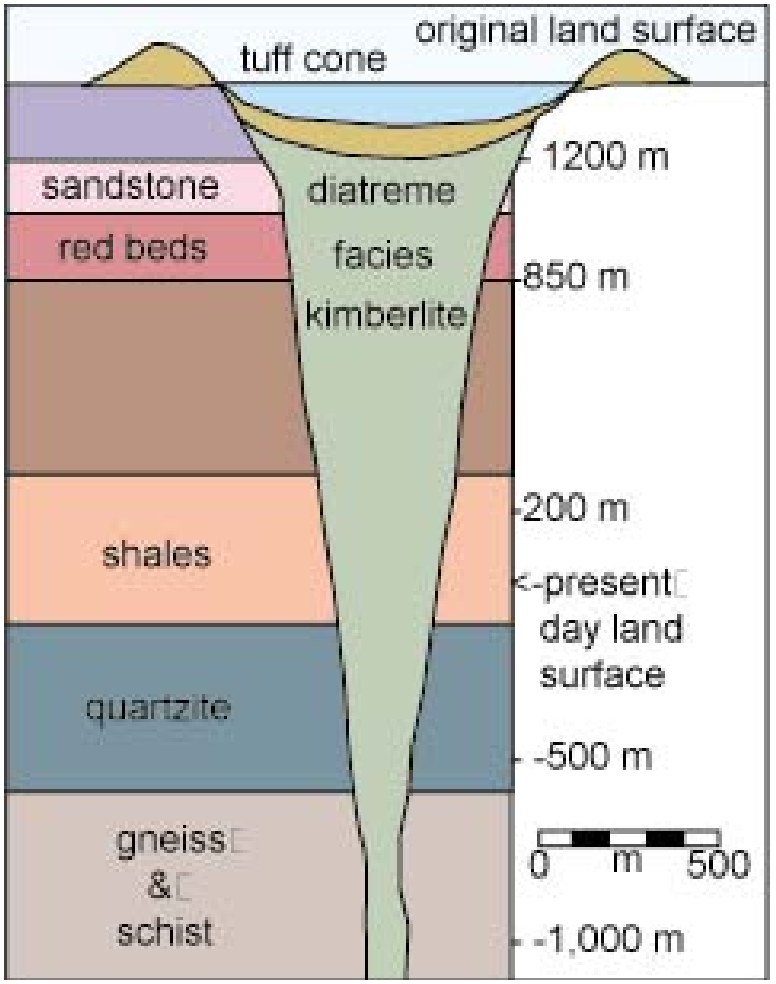
3) late stage weathering & open pit mining

4) Underground mining

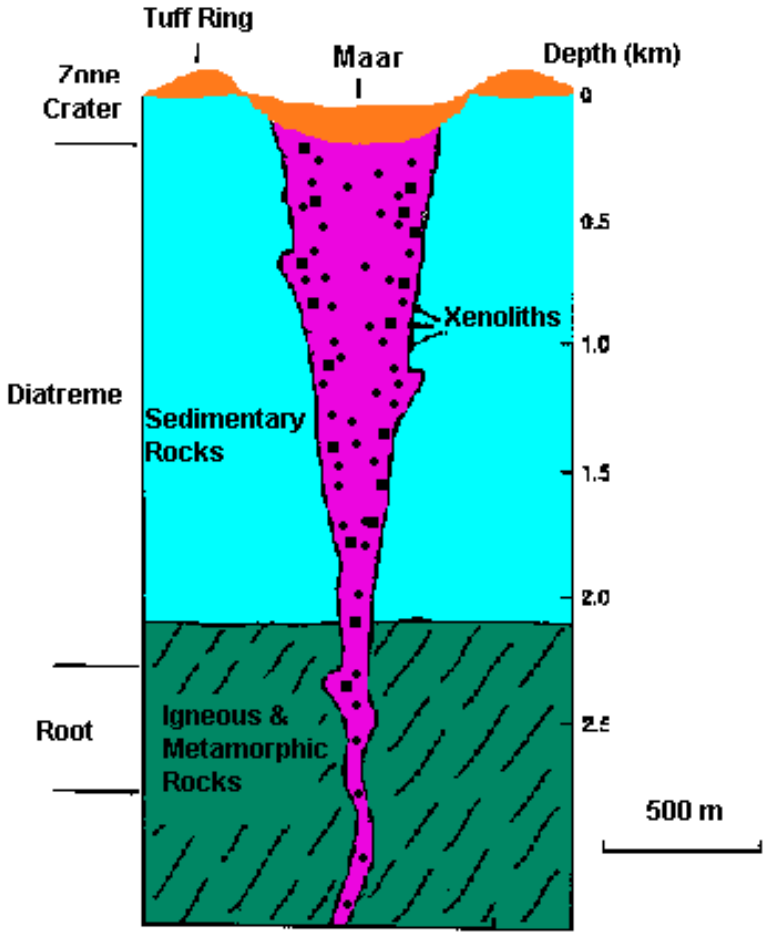
Primary Deposits

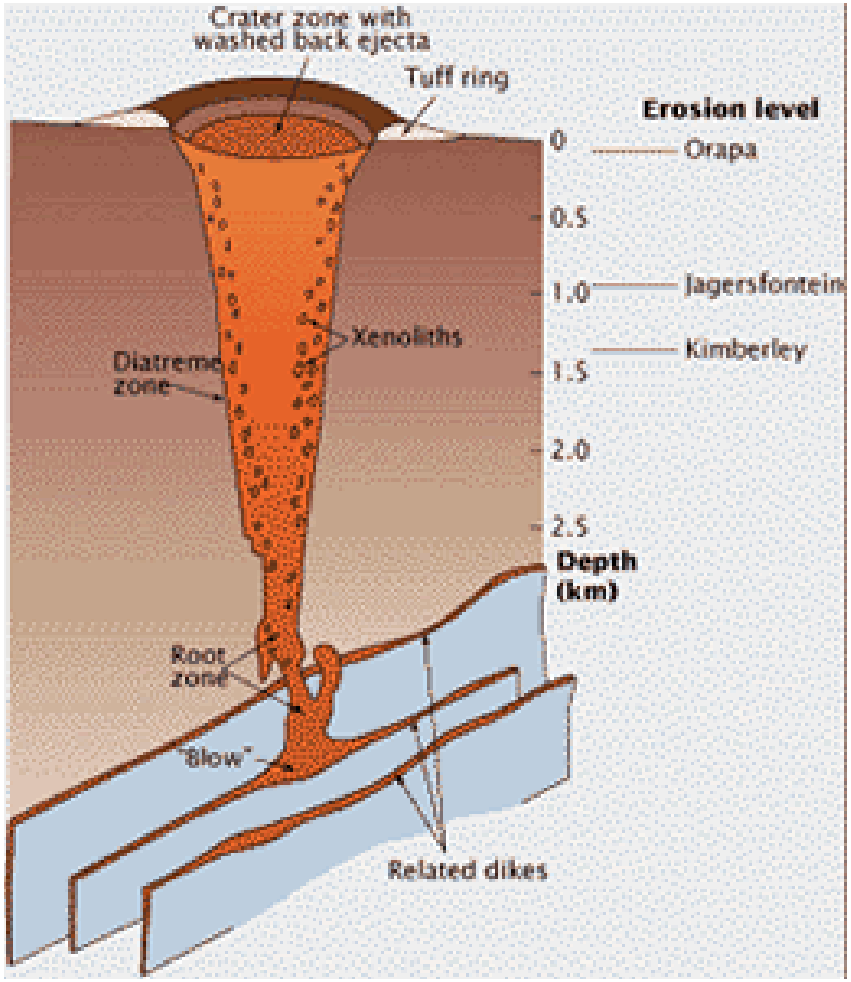
- These are igneous rocks that form from molten rock called magma
- The rock in which diamonds are found crystallizes in the crust but the diamonds originated within the earth's mantle. The diamonds are typically much older than the crustal rock they are found in and can be called xenoliths (Foreign rocks)

Diamonds are violently emplaced in eruptions. The carrot-shaped rock bodies are called diatremes



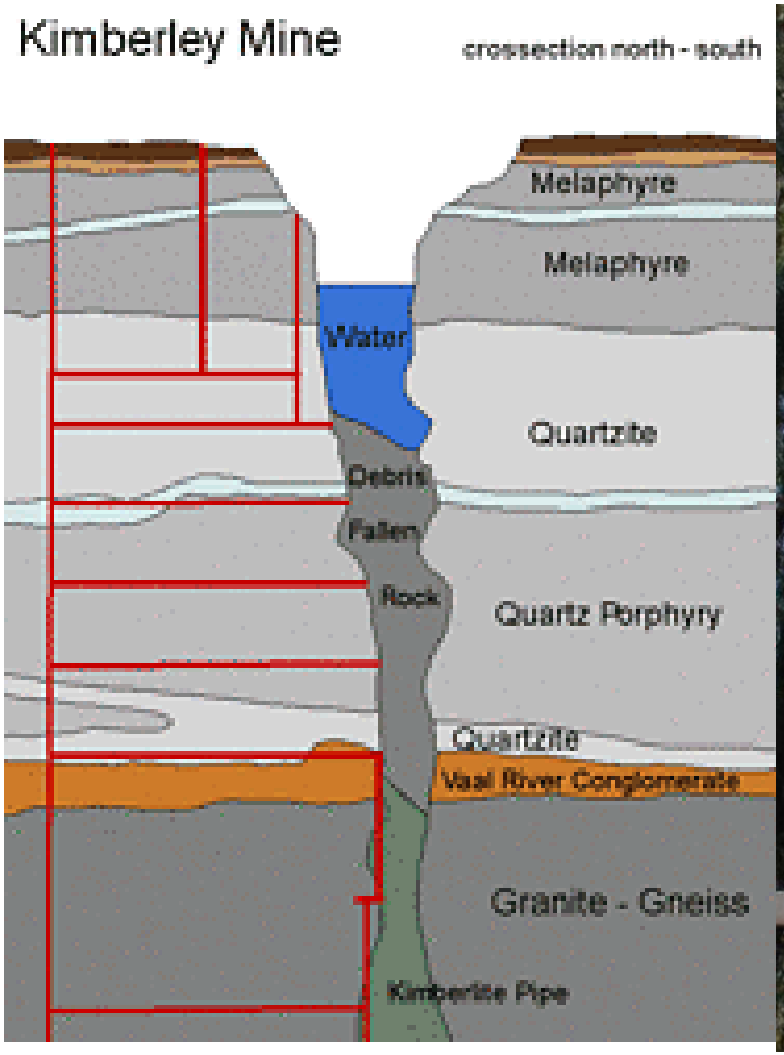
A closer look at a kimberlite pipe (or diatreme) emplace by volcanic activity



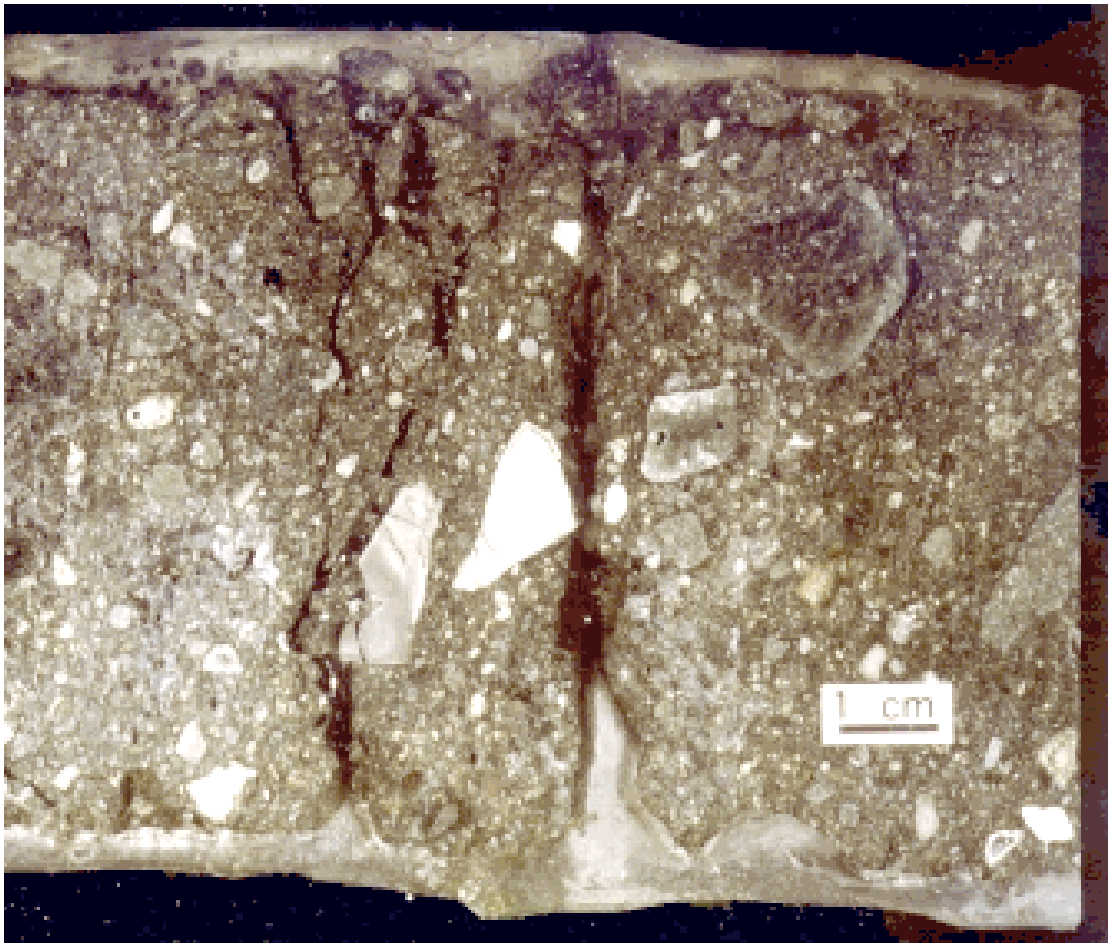


The Big Hole at the Kimberley Mine

The Kimberley Mine



Kimberlite the primary rock that contains diamonds



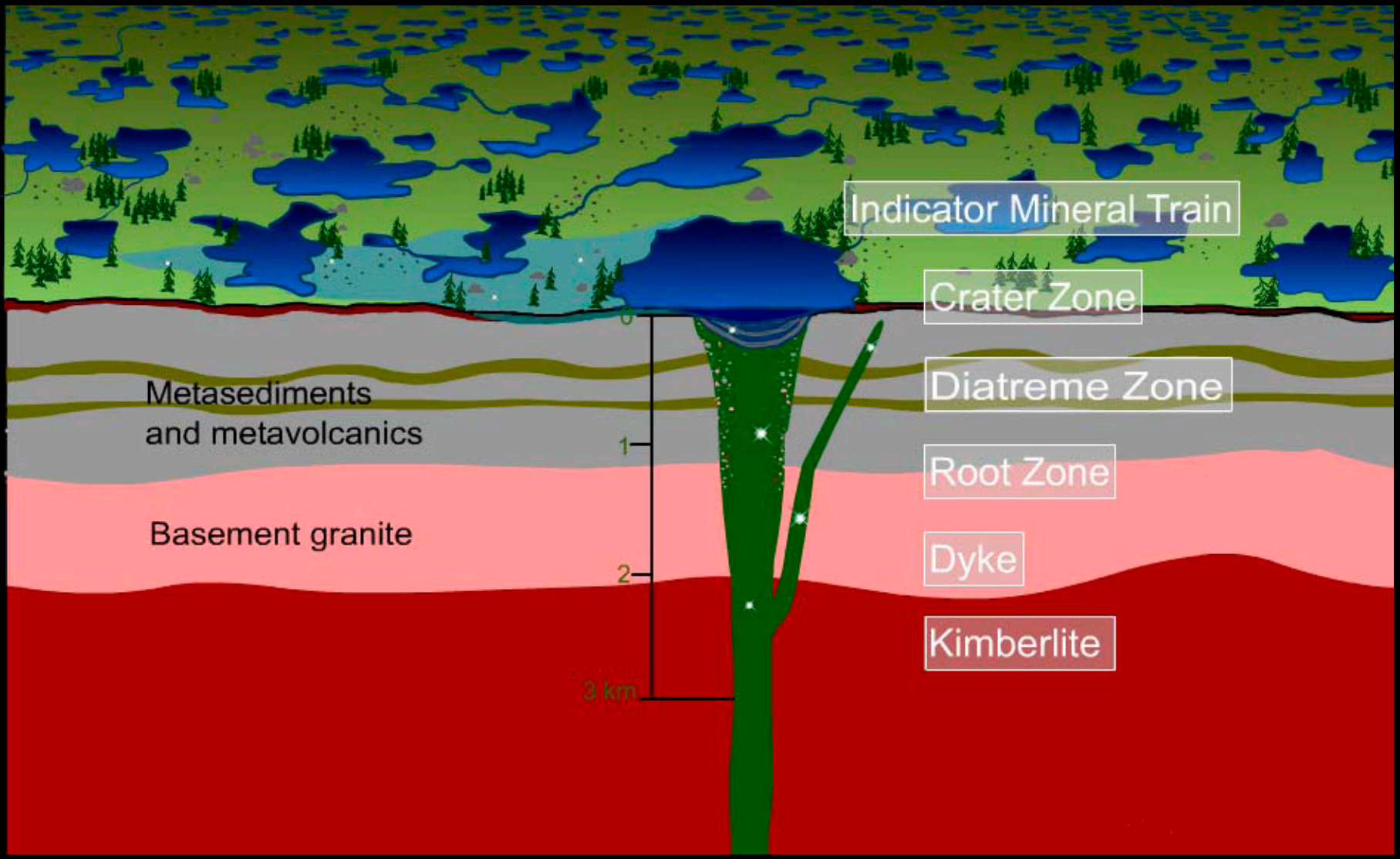
- Kimberlite is an igneous rock
- Formed from a melt
- Explosive emplacement makes it fragmental containing angular pieces of surrounding rock


0 cm
1
2
3
4 cm

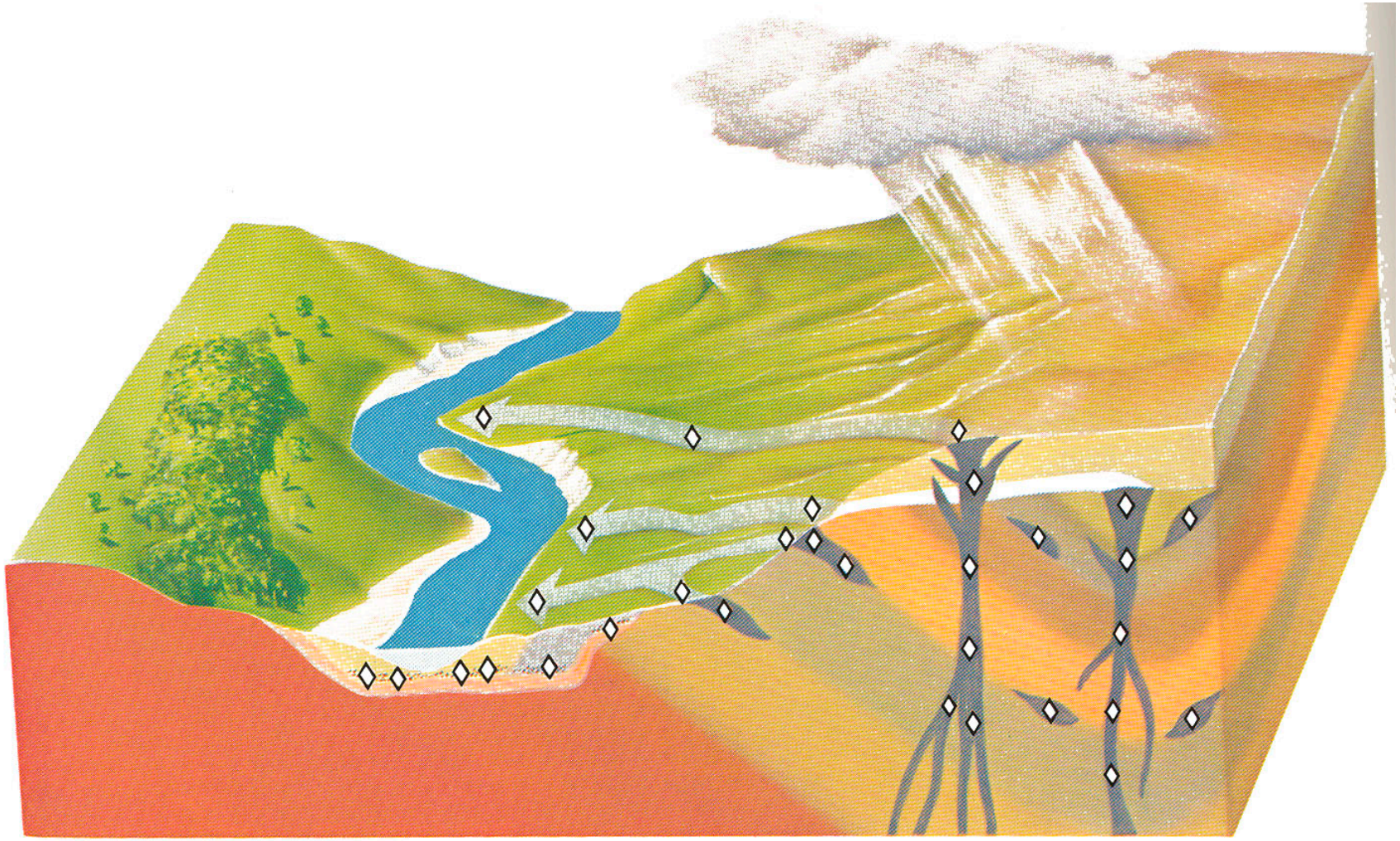
Prospecting for primary diamond deposits

- Kimberlite is from deep within the earth
- On the surface Kimberlite is out of equilibrium and weathers quickly (yellow ground)
- Kimberlite pipes are usually depressions
- Diamonds are resistant to weathering and wash into streams and finally to the sea

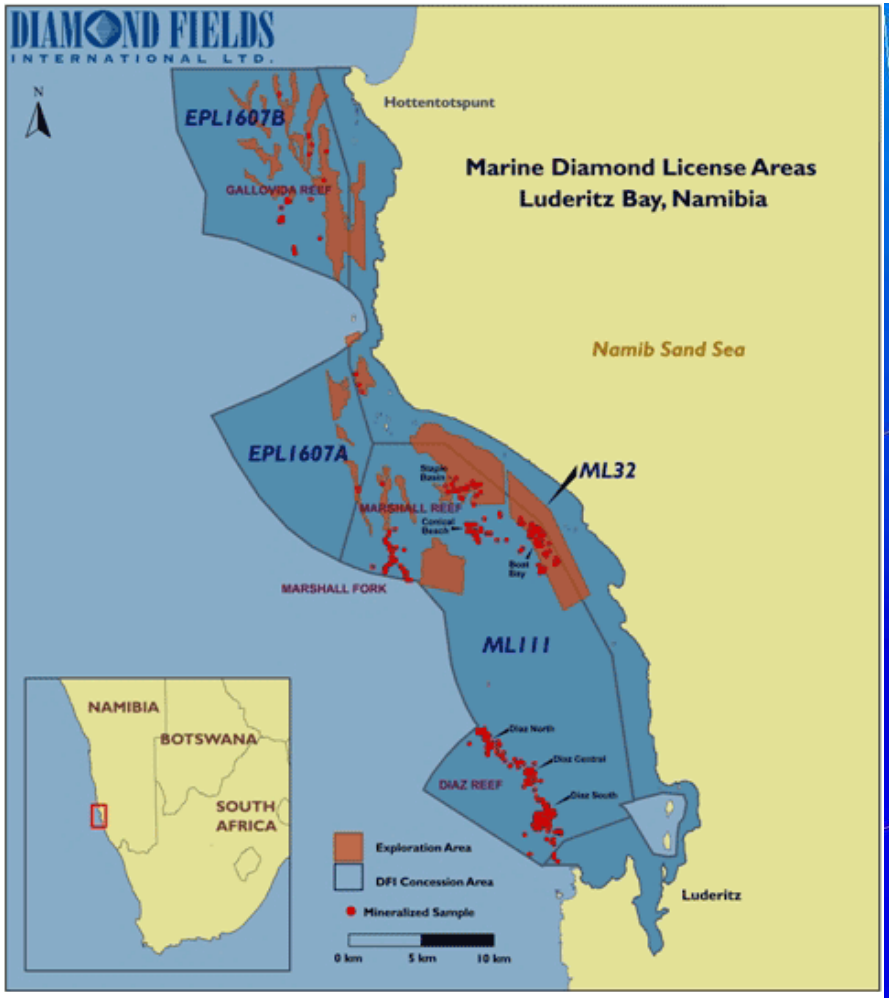
Kimberlite wears down and forms a lake, underneath is a diatreme

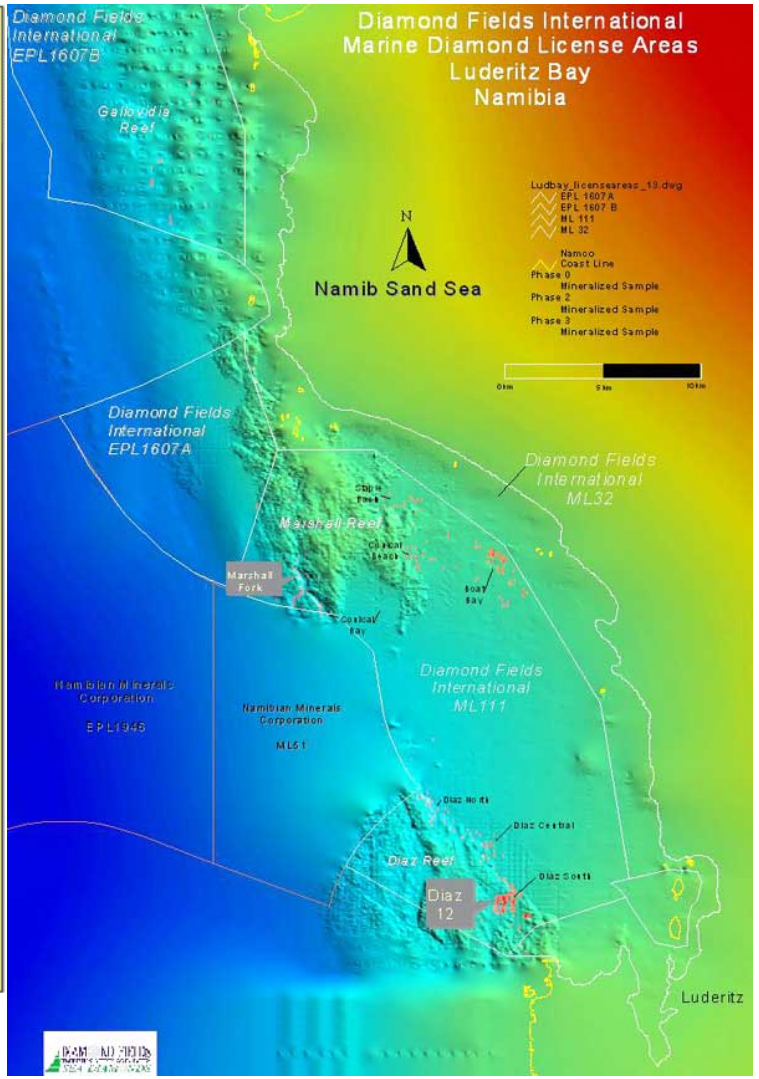


Diamonds wash into an alluvial deposit

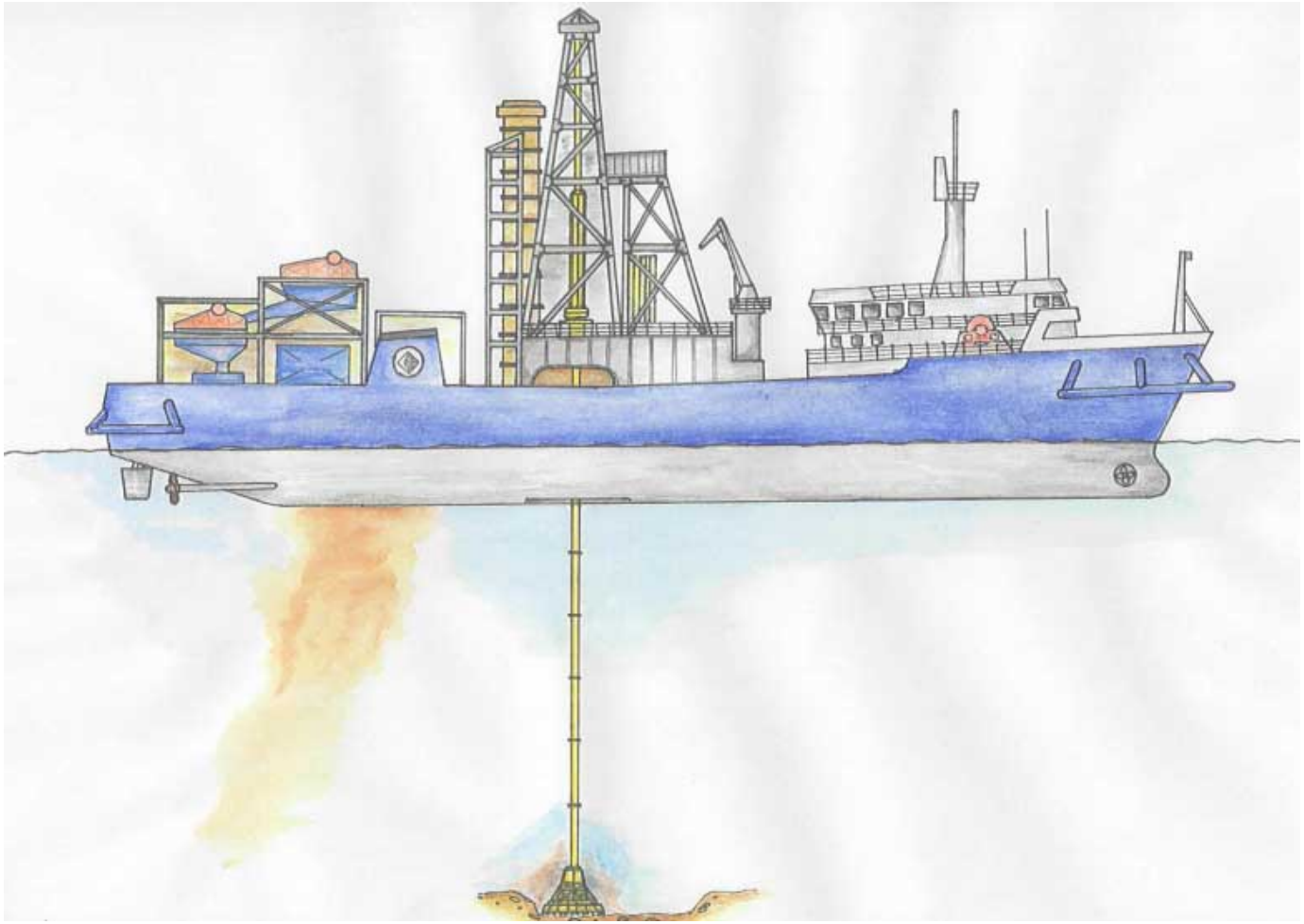


Ocean Diamonds off South Africa





Sucking diamonds off the Ocean Floor



Diamonds from off the coast of Namibia

Once Diamond Bearing rock is found you still need to concentrate on the diamonds

- Kimberlites and other deposits are not all diamond bearing or economically viable.

It is necessary to evaluate a deposit's diamond content:

1) **concentration** (carats per ton),

2) the **size** of the deposit, and

3) the **size and quality** of the diamonds.

Concentration

- A diamond concentration that would allow an economic would be between 0.1 & 0.5 carat per ton
- A very good concentration would range of 2 to 4 carats per ton.
- Some African mines operate only 1 carat of diamond per 10 tons and only about 1/3 are gem quality.

Separating diamond from the rock

- Diamond bearing rock is crushed and then separated. Several techniques are used

1) Grease tables– diamond sticks to grease

2) Density separation and hand picking

3) Electronic sorting using X-rays

Grease table

- One of the oldest methods of separating diamonds
- Water does not wet diamonds, but they stick to grease (e.g. Vaseline).
- Other rocks wash away but the diamond sticks to the grease table

Concentration followed by hand picking

- A glove box
- Enclosed in a glass case the picker can’t access the diamonds inside
- This method looks tedious, but grading at least to a certain extent can be done at the same time as separating the diamonds.

As Stones fly by, an X-ray unit and detector recognize diamonds by fluorescence, and a jet of air separates them from the stream.

Grading Diamonds

- Some diamonds are **gems** having high clarity, good color, and few inclusions

- Some diamonds are graded as **Industrial** or **Bort** because of a failing in one of these respects, for example, black diamonds

Diamonds are graded on 4 Cs

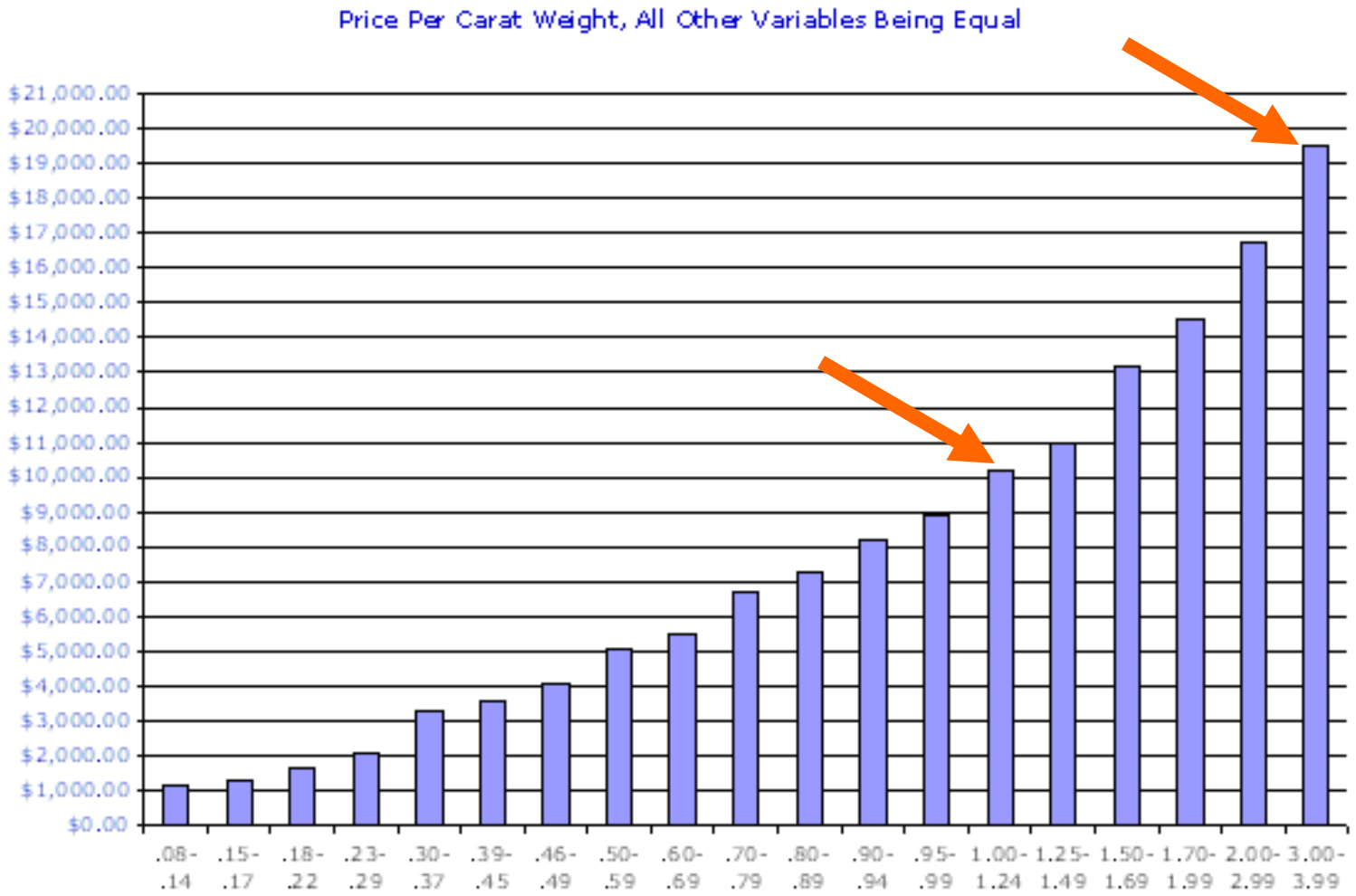
- Carat
- Color
- Clarity
- Cut

Except for the last character the grade of a diamond is in nature’s hands.

Carat = 0.2 grams

- The larger a stone for a particular grade of diamond the more valuable it is.
- The term carat is derived from a type of seed that was of very uniform size and could be used for weights in the gem industry.
- Each carat can be broken into 100 points, large stones are given as decimals of a carat

Value increases in jumps as weight increase



Price per carat

- According to the chart: If a one carat stones retails for $10,500, a 3 carat stone of the same grade of quality would sell for $19,500 per carat for at total price of $58,500.

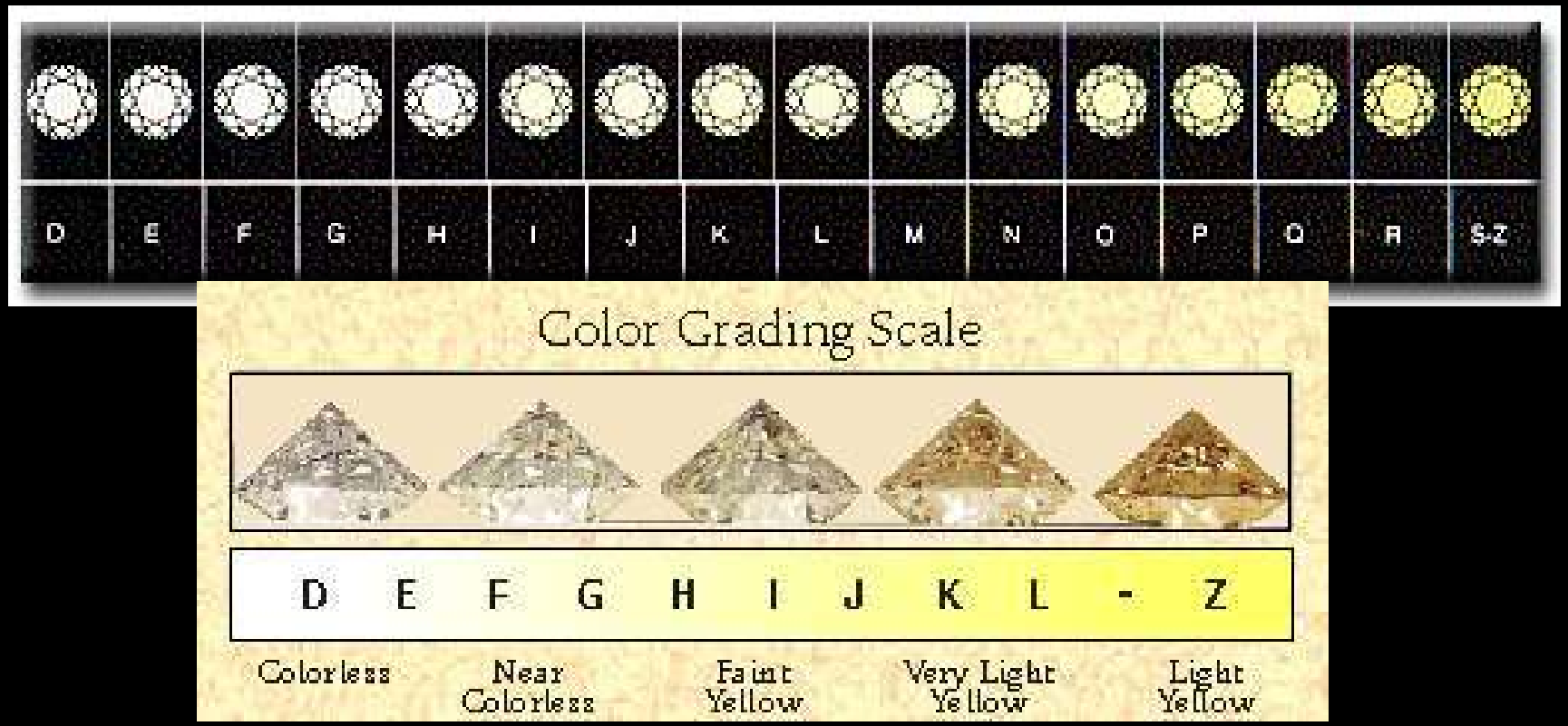
- Clearly larger stones are rare and more valuable

Color

- There are several scales used to compare color. See P. 87 of Simon and Schuster.
- Old mine, United Kingdom, GIA, CIBJO (International Confederation Of National Jewelry Trade Organizations)
- In the United States the GIA system is almost universally used.

GIA Color Grades Use Letters

D is the colorless Z is colored a strong yellow



GIA Color Grades (Cont…)

- D-E-F - The three of them are 'Colorless'. The only difference between each of them is transparency with D being the most transparent.
- G-H-I - 'Near Colorless' category. With G being highest grade in this section. No color can be seen face up but very slight yellow can be seen face down.

GIA Color Grades (Cont…)

- J-K-L-M - After J, an untrained individual can see the diamond color with his naked eye. This comes in the 'Slightly Yellow' category. Face up - very slight yellow and face down - slight yellow.

- N-Z - 'Yellow' category. The yellow color is obvious face up and face down. Anything beyond that is Z or beyond is a 'Fancy' colored diamond

Fancy Colors are extremely valuable

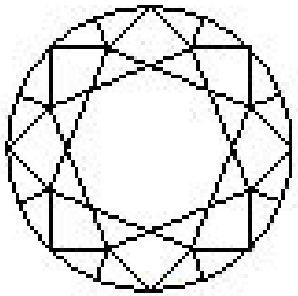
Fancy Colors are extremely valuable

Hope Diamond 45.52 carats

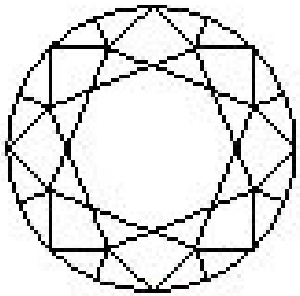
Clarity

- Diamonds clarity is of about equal value to color in assessing a diamonds value
- It is #2 on the list of the 4cs
- Clarity is determined by amount of inclusions and fractures

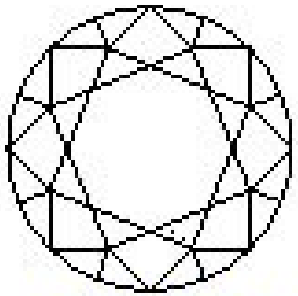
The Scale used by GIA is most important



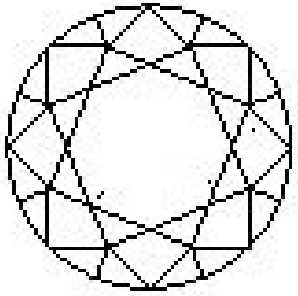
FI
(Flawless)



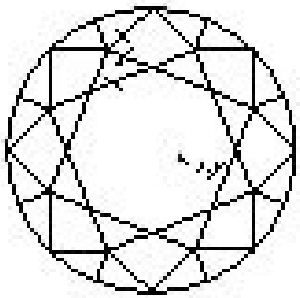
IF
(Internally Flawless, minor surface blemishes)



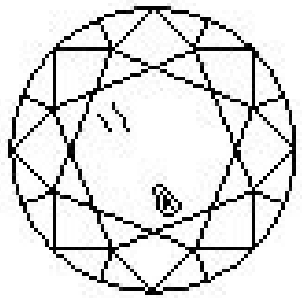
VVS1-VVS2
(Very, very small inclusions)



VS1-VS2
(Very small inclusions)

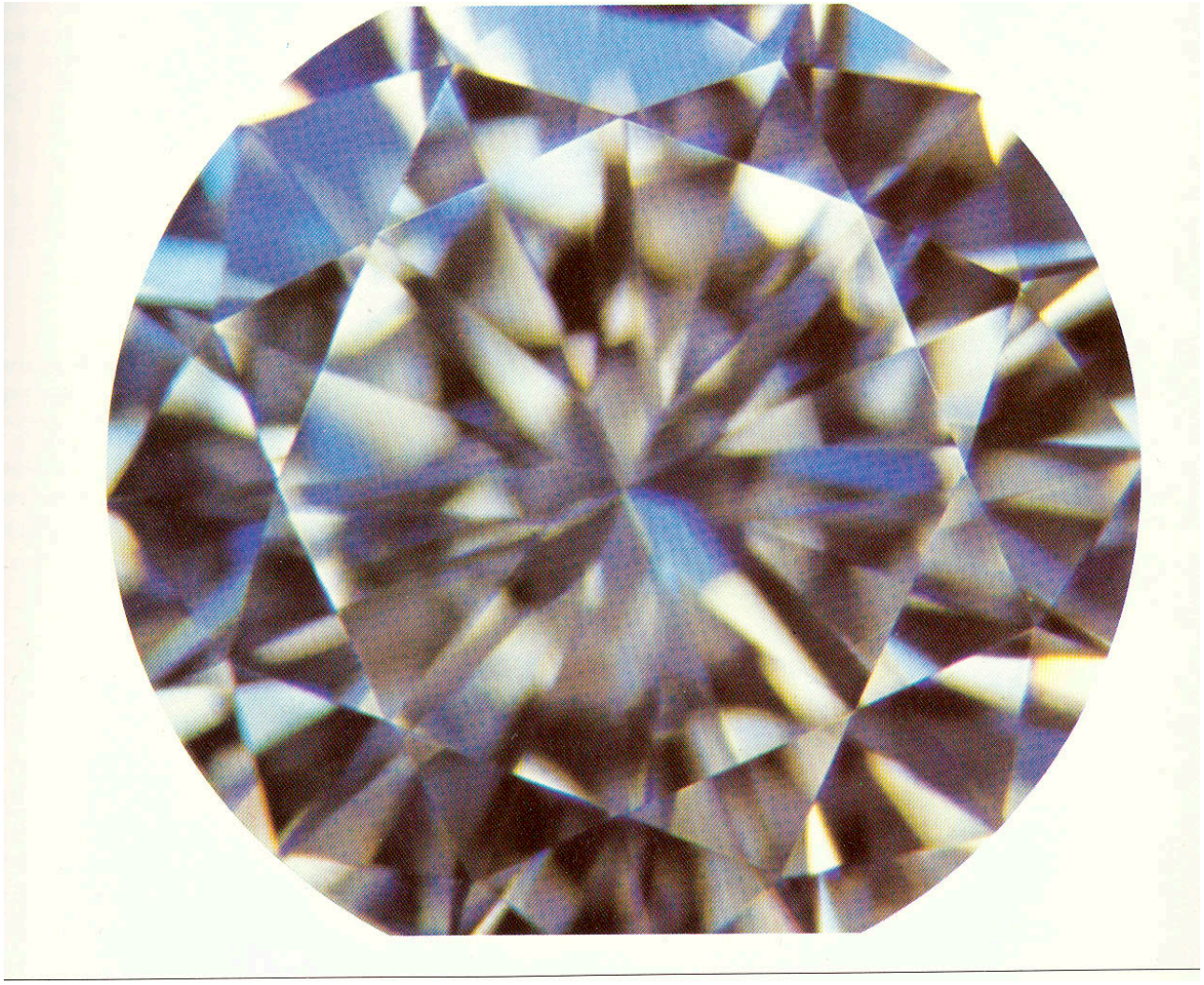


SI1-SI2
(Small inclusions)

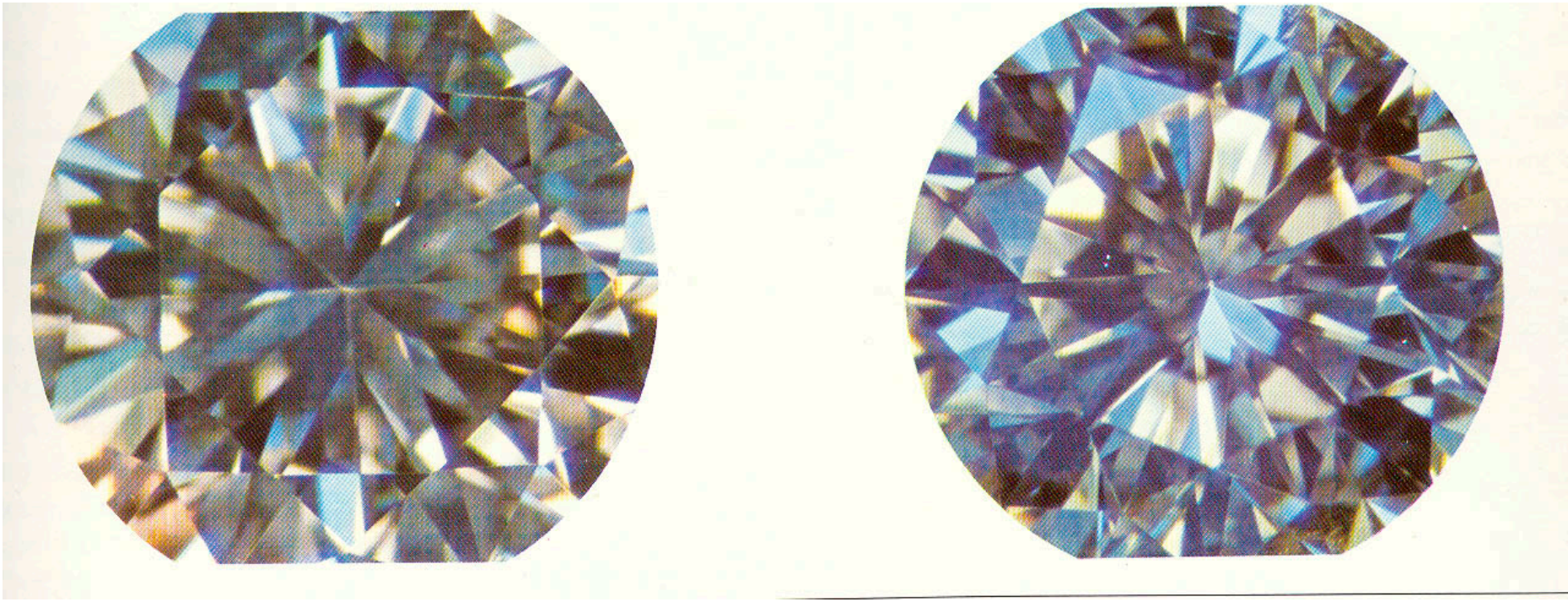


I1-I2-I3
(Imperfect-eye-visible inclusions)

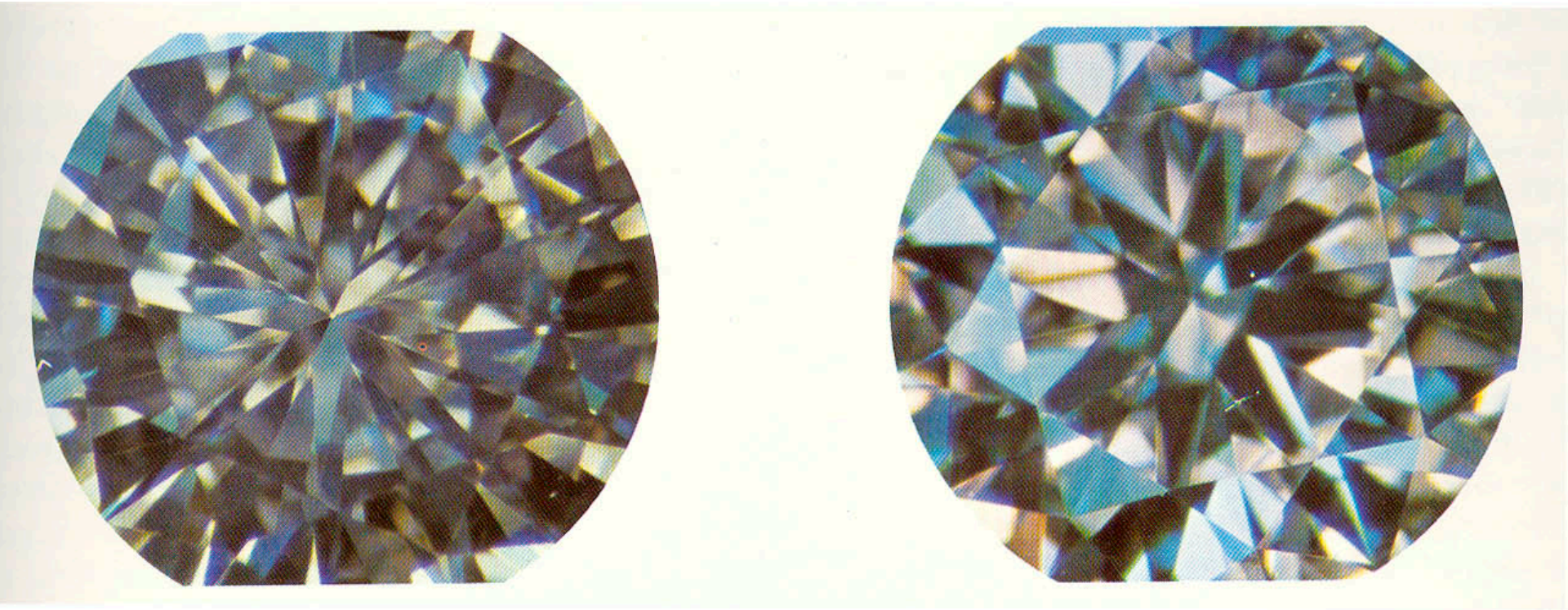
Flawless (Gubelin, 1980)



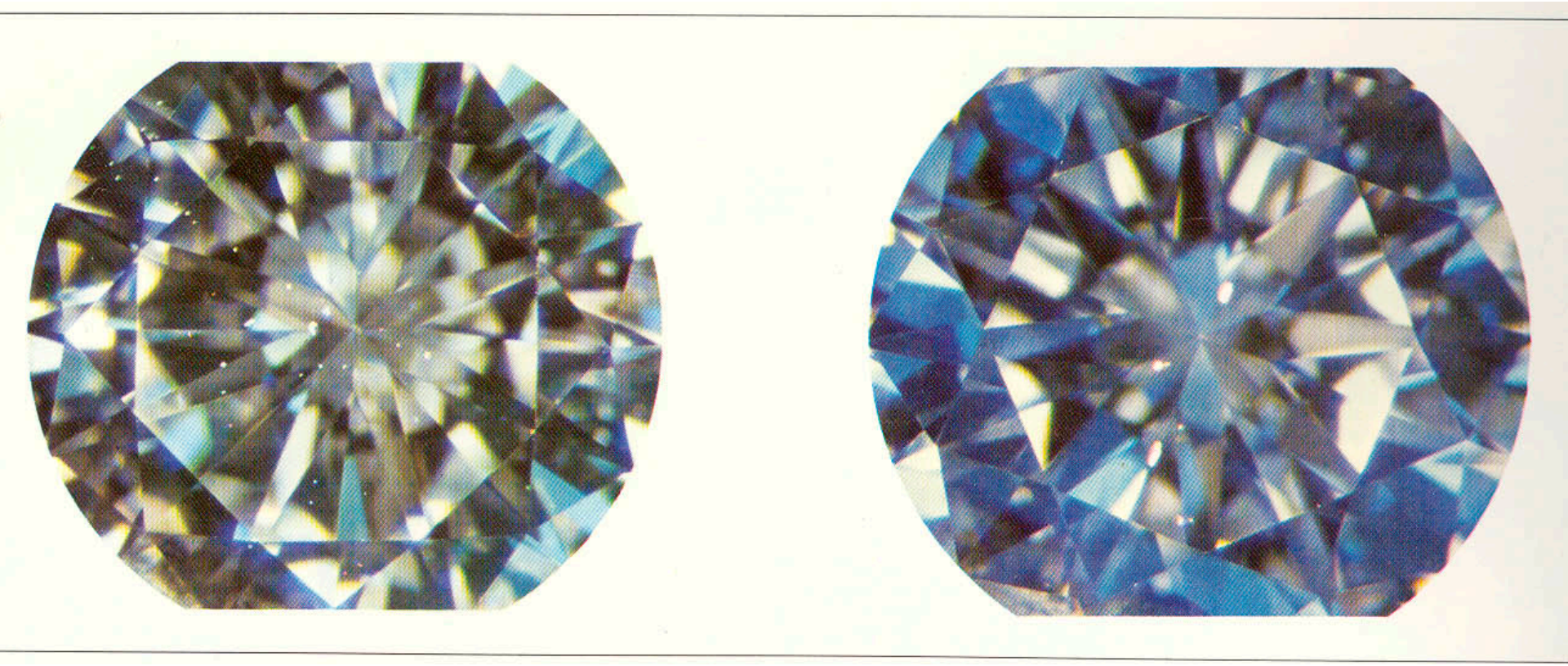
VVS Clarity



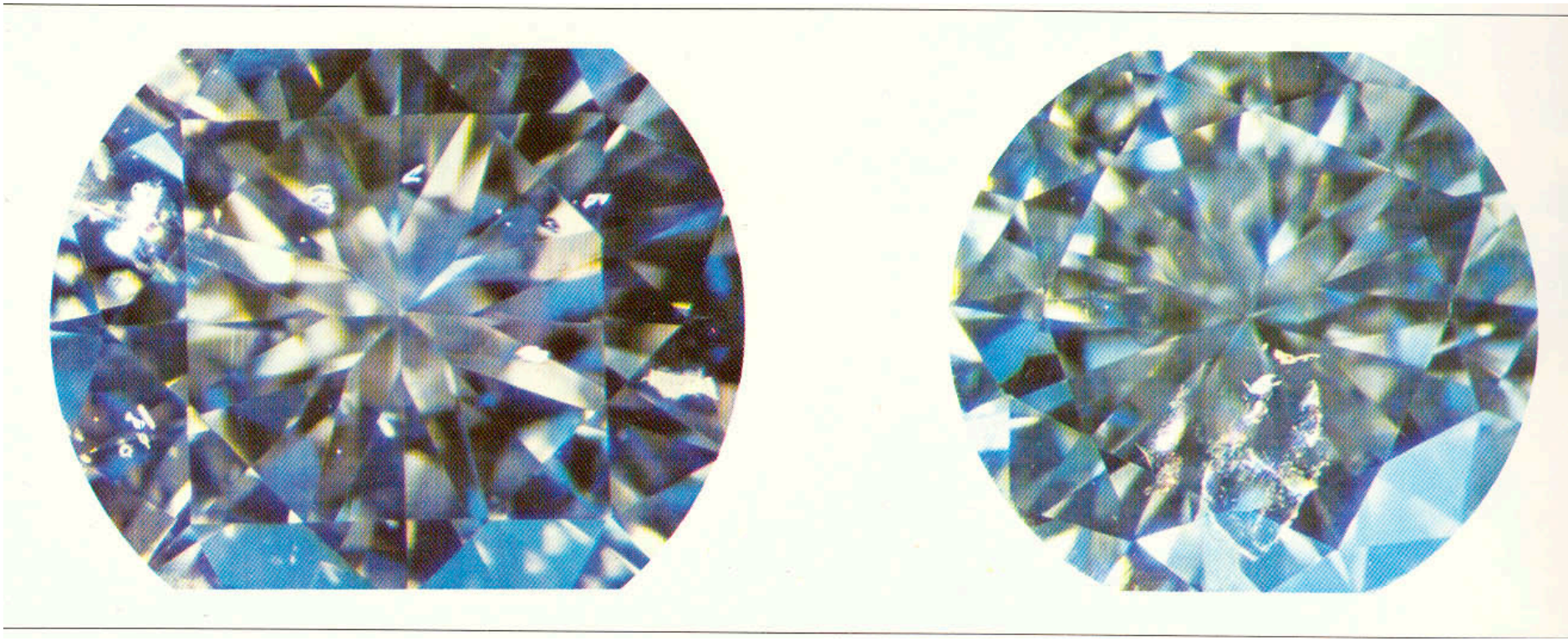
VS Clarity



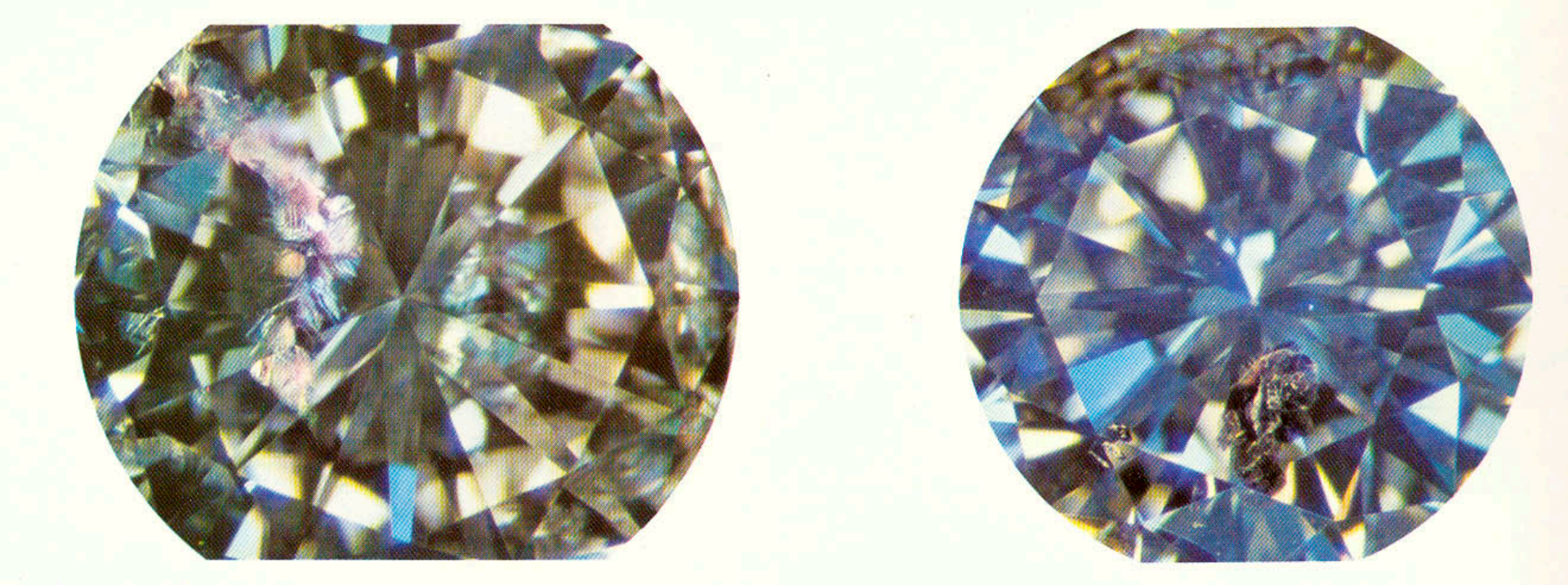
SI Clarity



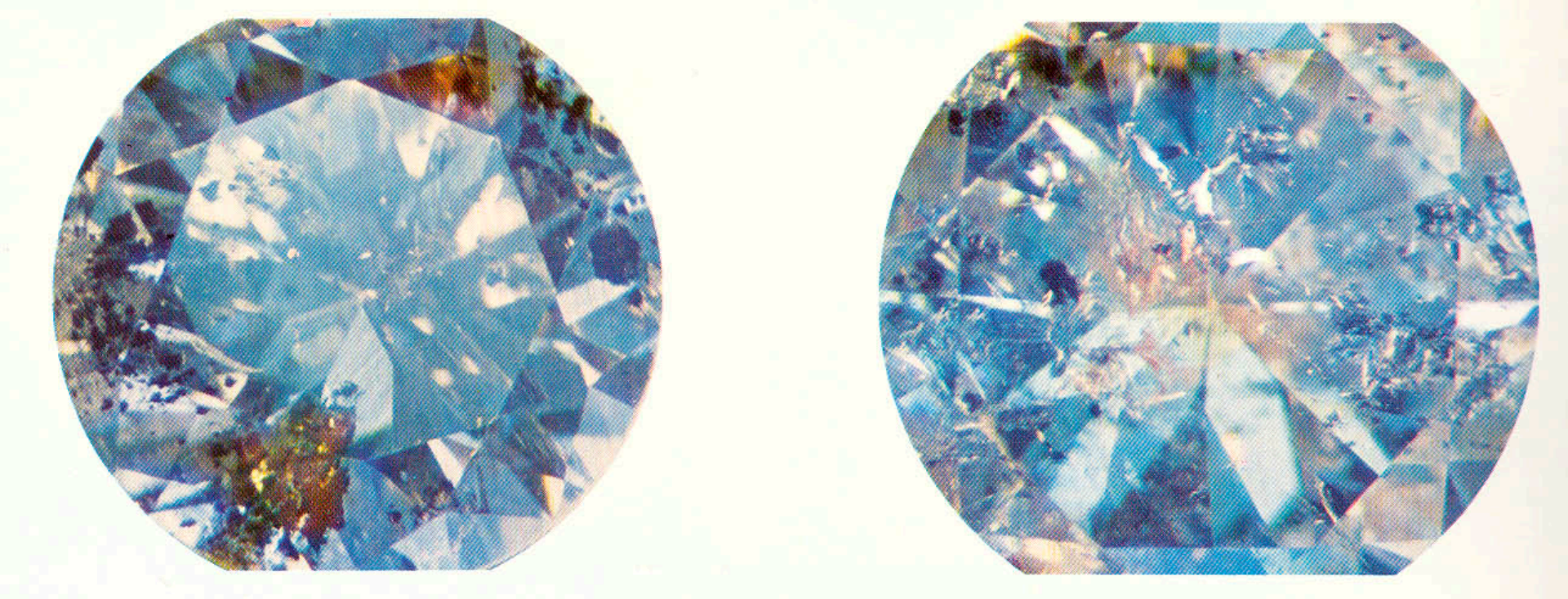
P1 Clarity



P2 Clarity



P3 Clarity




GIA CERTIFIED DIAM
JAMES & CO
GIA
1.59 I VS1
GIA
1.22 G VS2
GIA
.57 D VS2
GIA
1.70 E SI2
GIA
.77 H VS2
GIA
1.28 J VS2
GIA
1.01 J VS1
GIA
1.30 I VS2

CUT

We already did Cut