## 8. Quantitative and other methods in reflected-light microscopy

### Microhardness (VHN)

The determination of relative polishing hardness is used in the mineral identification. However, hardness can be measured quantitatively using micro-identification techniques. The frequently used hardness value, the Vickers hardness number (VHN). Micro-identification hardness is the most accurate method of hardness determination and, in the case of Vickers technique, involves pressing a small square-based pyramid of diamond into the polished surface. The diamond may be mounted in the centre of a special objective with bellows enabling the load to be applied pneumatically (Fig. 1). The Commision on Ore Microscopy (COM) recommends that a load of 100g should be applied for 15s.

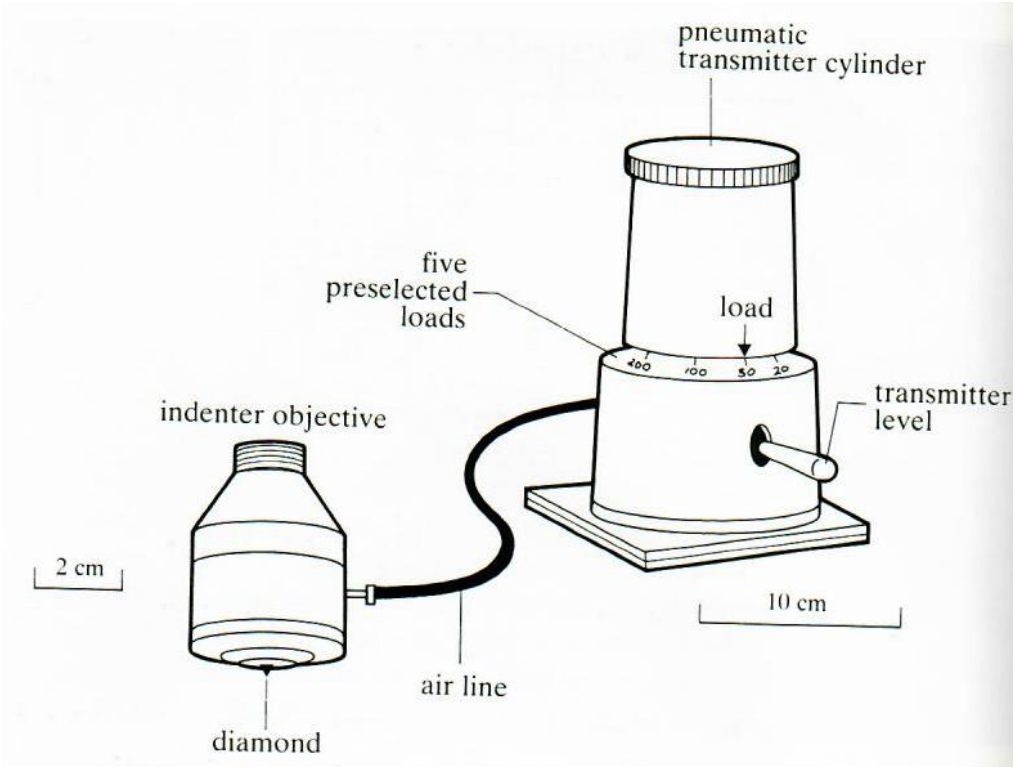


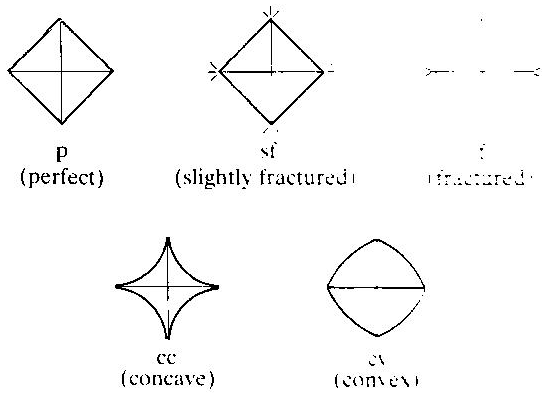

*Fig. 1. The Vickers micro-identification hardness tester (according to Gribble a Hall 1992)*

The size of the resulting square-shaped impression depends on the hardness of the mineral:

VHN= 1854 x load/$d^2$ kg/$mm^2$

- where the load is in kg and d is the average length of the diagonals of the impression in microns.

Hardness is expressed in units of pressure; that is, force per unit area. Thus the micro-indentation hardness of pyrite is written: pyrite, $VHN_{100}$= 1027-1240 kg/$mm^2$
The subscript 100 may be omitted, as this is the standard load. As VHN values are always given in kg/$mm^2$ the unit is also often omitted.
The determination of hardness is relatively imprecise technique, so an average of several indentations should be used. Tables of VHN usually give a range of values for a mineral, due to compositional variations, anisotropy of hardness, and uncertainity. Brittleness, plasticity and elasticity control the shape can be useful in identification, the COM recommends that indentation shape (using the abbreviations given in Fig. 2) be given with VHN values.




*Obr. 2. Indentation shapes (according to Gribble a Hall 1992)*

There is a reasonable correlation between VHN and Mohs scratch hardness, as shown in Fig. 3)

| Mohs' hardness (H) | | ~ VN |
|---|---|---|
| 1 | talc | 10 |
| 2 | gypsum | 40 |
| 3 | calcite | 100 |
| 4 | fluorite | 200 |
| 5 | apatite | 500 |
| 6 | orthoclase | 750 |
| 7 | quartz | 1300 |
| 8 | topaz | 1700 |
| 9 | corundum | 2400 |
| [10 | diamond] | |

*Obr. 3. Relation between VHN and Mohs´ hardness (according to Gribble a Hall 1992)*