

## 科目名稱：地球物質 (礦物部分共 50 分)

- 一、簡答題：下列是摘自礦物學課本對 *Rhodonite* 之描述性資料，請在詳細閱讀後按照題號簡單且完整的回答本題的 10 個小題。(注意：除專有名詞可寫英文外，照抄英文得零分)【共 20 分】

**Rhodonite—MnSiO<sub>3</sub>**

**Crystallography.** Triclinic;  $\bar{1}$ . Crystals commonly tabular parallel to {001}; often rough with rounded edges. Commonly massive, cleavable to compact; in embedded grains.

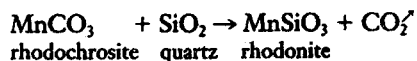
$P\bar{1}$ ;  $a = 7.79$ ,  $b = 12.47$ ,  $c = 6.75$  Å;  $\alpha = 85^\circ 10'$ ,  $\beta = 94^\circ 4'$ ,  $\gamma = 111^\circ 29'$ ;  $Z = 10$ .  $d_s$ : 4.78(4), 3.15(5), 3.09(3), 2.98(8), 2.93(9), 2.76(10).

**Physical Properties.** *Cleavage* {110} and  $\{\bar{1}\bar{1}0\}$  perfect.  $H$   $5\frac{1}{2}$ –6.  $G$  3.4–3.7. *Luster* vitreous. *Color* rose-red, pink, brown, see Plate VI, no. 4; frequently with black exterior of manganese oxide. Transparent to translucent. *Optics*: (+);  $\alpha = 1.716$ –1.733,  $\beta = 1.720$ –1.737,  $\gamma = 1.728$ –1.747;  $2V = 60^\circ$ –75°,  $r < v$ .

**Composition and Structure.** Rhodonite is seldom pure MnSiO<sub>3</sub>, but contains some Ca, with a maximum CaSiO<sub>3</sub> content of about 20 molecular percent. Fe<sup>2+</sup> may replace Mn up to as much as 14 weight percent FeO. Zn may be present, and Zn-rich varieties are known as *fowlerite*. The structure of rhodonite consists of SiO<sub>3</sub> chains, parallel to the  $c$  axis, with a unit repeat of five twisted tetrahedra. Layers of cations alternate with the chains. The structure is similar to that of wollastonite, and pyroxmangite, (Mn,Fe)SiO<sub>3</sub>.

**Diagnostic Features.** Characterized by its pink color and near 90° cleavages. Distinguished from rhodochrosite by its greater hardness and good cleavage.

**Occurrence.** Rhodonite is uncommon and occurs in manganese deposits and manganese-rich iron-formations, as a result of metamorphic and commonly associated fluid infiltration. It may form from rhodochrosite by the reaction:



Rhodonite is found at Långban, Sweden, with other manganese minerals and iron ore; in large masses near Sverdlovsk in the Ural Mountains, Russia; and at Broken Hill, New South Wales, Australia. In the United States rhodonite occurs in good-sized crystals in metamorphosed limestone with franklinite, willemite, zincite, and so forth, at Franklin, New Jersey.

**Use.** Some rhodonite is polished for use as an ornamental stone. This material is obtained from the Ural Mountains, Russia, and Australia.

**Name.** Derived from the Greek word for *a rose*, in allusion to the color.

**Similar Species.** *Pyroxmangite*, (Mn,Fe)SiO<sub>3</sub>, is structurally very similar to rhodonite, but with a unit repeat of seven tetrahedra in the SiO<sub>3</sub> chain. *Pyroxferroite*, Ca<sub>0.15</sub>Fe<sub>0.85</sub>SiO<sub>3</sub>, isostructural with pyroxmangite, is a relatively common mineral in lunar lavas. *Bustamite*, (Mn,Ca,Fe)SiO<sub>3</sub>, is very similar in structure to wollastonite. All of these pyroxenoids have extensive fields of solid solution. *Tephroite*, Mn<sub>2</sub>SiO<sub>4</sub>, a red to gray mineral associated with rhodonite, is isostructural with olivine.

1. *Rhodonite* 的中文名稱是什麼？屬於哪一個晶系？
2. *Rhodonite* 屬於哪個點群？哪個空間群？
3. *Rhodonite* 的硬度是多少？比重是多少？
4. *Rhodonite* 具有什麼斷口？什麼光澤？
5. *Rhodonite* 的一個晶胞中含有多少個原子？常覆蓋在表面的黑色物質是什麼化學成分？
6. *Rhodonite* 的折射率最高可達到多少？最強 X 光繞射發生在哪一晶面間距？(答案應附單位；單位錯誤得 0 分)
7. *Rhodonite* 有哪兩項明顯鑑定特徵？
8. 哪兩項明顯特徵差異可用來鑑定區別 *rhodonite* 與 *rhodochrosite*？
9. *Rhodonite* 有什麼用途？常與哪一種具橄欖石構造的礦物共生？
10. *Rhodonite* 名稱是從哪種文字來的？原文代表什麼意思？

見背面

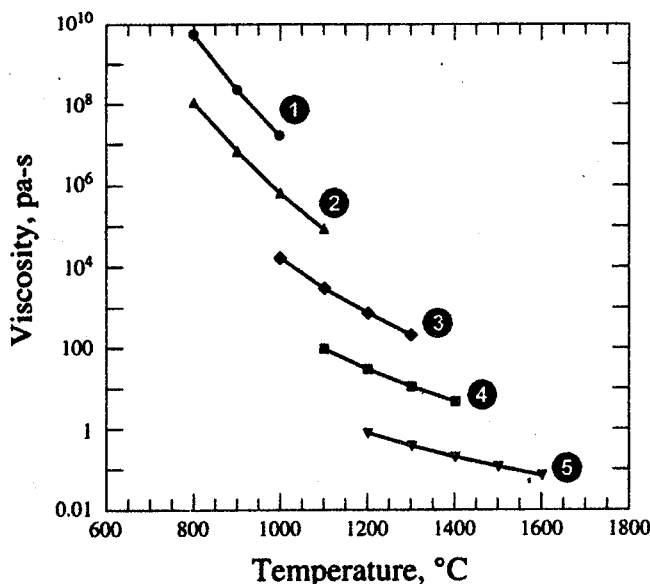
二、結晶學通常採用 Miller indices 來表示結晶面，用向量方式來表示方向，而不同的括弧與數字所代表的含意也不同。請問：(1) (111)、[111]、{111}三者各代表什麼意思？(2)上述三者在此「等軸晶系最高對稱晶族」與「三斜晶系最高對稱晶族」中，所代表的內容含意有何異同？【共 15 分】

三、解釋名詞：【每題 5 分，共 15 分】

- (1) Mohs scale
- (2) Optical indicatrix
- (3) Polymorphism

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一、下圖是五種火成岩 magma (①至⑤) 的 viscosity 對 temperature 的變化圖。今已知這五種火成岩的英文名稱 (按字母順序) 為：Andesite, Basalt, Dacite, Komatiite, 與 Rhyolite。請問：(1)這五種岩石的中文名稱分別為何？(2)圖中從①至⑤各代表何種火成岩 magma 的 viscosity 變化？(3)請簡述圖中各 magma 會呈現規律排列的主要原因？【共 20 分】



二、某地新鮮露頭發現三種岩石，分別是玄武岩、石灰岩、大理岩。已知此處並無斷層、不整合等構造，也無山崩、人類活動等擾動，且知其中一種岩石的年代較老，另兩種岩石年代相似。請問：(1)此處的三種岩石各屬於三大岩類的哪一類岩石？(2)最可能較老的是哪一種岩石？(3)簡述此露頭最可能與合理的地質形成過程。【共 15 分】

三、解釋名詞：【每題 5 分，共 15 分】

- (1) Migmatite
- (2) Ophiolite
- (3) Turbidite