SHORTER COMMUNICATIONS

CAVITY-FILLING KYANITES FROM SUKINDA, CUTTACK DISTRICT, ORISSA

S. MITRA
Department of Geological Sciences, Jadavpur University, Calcutta

Introduction: Giant bluish grey kyanite crystals occur as twinned aggregates as cavity-filling in a quartzite to the north of a small village Ostia Sukinda in the foothill region of Daiteri range (85°45′ – 85°57′ E : 21°6′ 30″ N), composed of Precambrian banded iron ore formations. The crystals are twinned normal to (121) and (100). The dimensions of the crystals range from 3 to 5 cm in a – direction, and in length they are over 14 cm.

Mineralogy: Qualitative microprobe analysis of the crystal faces, free from any inclusion, by laser showed traces of potassium and barium, besides aluminium, iron and titanium.

X-ray diffraction investigation showed numerous lines with varying intensities, and these were compared with those of the A. S. T. M. synthetic disthene. More reflections than in previous reports are observed in the high angle region.

Optically the crystals are negative with $2V = 83°$, $N_x = 1.713$, $N_y = 1.722$, $N_z = 1.729$. $N_z - N_x = .016$.

From the X-ray data, the geometry of the unit cell is computed with the following results:

$a_0 = 7.09$	$\alpha = 90°5.5'$
$b_0 = 7.72$	$\beta = 101°2'$
$c_0 = 5.56$	$\gamma = 105°\ 44.5'$

Under the microscope kyanite shows replacement relation with muscovite, quartz and magnetite; ilmenite and rutile are developed within the body of kyanite (Figs. 1 & 2).

Other occurrences: Kyanite-bearing veins occurring within a quartzite ridge flanked by mica schists were earlier reported from India by Banerjee (1954). He also noted the association of rutile. Similar ionic radii of aluminium (.57 Å) and titanium (64 Å) may account for the common association of kyanite and titanium-bearing minerals (Alderman, 1942).

Occurrence of kyanite in random orientations in veins, in cavities and joints is well known (Read, 1933; Miyashiro, 1951; Kostov, 1960). Hills (1938) suggested that alumina in excess of the requirements of the felspars and micas may exist in liquid phases developed from granitic magmas and may give rise to pyrogenic andalusite and sillimanite. Dunn (1942) ascribed the Al-enrichment of late magmatic liquids to assimilation of alumina from aluminous sediments on their way upwards.

In the present case however the author ascribes the genesis of kyanite-quartz-muscovite rock as a secretion product during regional metamorphism of quartzite and quartz-mica schists in a very low water pressure. The orogenic movement causing the uplift and metamorphism of the sediments to the present banded quartzite, and quartz-mica schist, produced fissures, which are the sites for the formation of felspar-quartz 'secretion' pegmatite veins. At the initial stage of deformation chemical gradient developed towards the fissures where the drop in chemical potential for these mobile components viz. SiO_2, K_2O, H_2O_3 etc. was at the maximum. The quartzite environment in the immediate vicinity lacked in sufficient supply of alkalies to form felspars, and kyanite formed instead; at a later stage alkali supplies were possible for the formation of muscovite which started replacing kyanite.

Figure 1. Cavity-filling kyanite being replaced by quartz. The latter enclosing ore minerals (ilmenite and magnetite), in polarised light × 90.

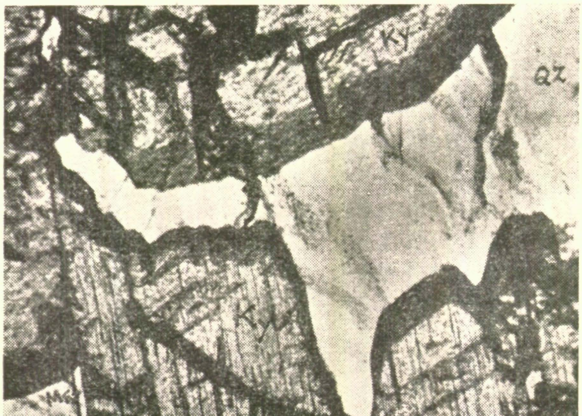

Figure 2. Kyanite and quartz association, relict grains of muscovite are occasionally found in the body of kyanite.

Kyanite of Ostia shows evidence of static growth. The tectonic overpressure due to the intrusion of the ultrabasics or later granite (Haller, 1962, p. 23) may not be a plausible reason in the present area. Tectonic overpressures could have been responsible for the growth of kyanite around granite-gneiss domes in Aukole, Uganda (Clark, 1961). Post-tectonic kyanite grown within undeformed pseudomorphs of mica after andalusite has been reported by Nicholson (1964).

Haller (1962) has shown that kyanite-staurolite zone is parallel to a major migmatite sheet and occupies the intensely deformed zone of detachment adjacent to the infra-structural substratum. This could be interpreted as evidence in favour of tectonic overpressures in this zone, but higher temperature and extremely plastic structures do not suggest that any such overpressures were high. Moreover, Haller suggests that crystallisation mainly followed deformation.

Conclusions: The laboratory investigations of Al_2O_3 systems with other components seems to be remote from certain geological environments, mainly because in the laboratory investigations, we deal mostly with the polymorphic inversions rather than the kinetics of reaction and nucleation occurring in nature By changing T-P in a $Al_2O_3 - SiO_2$ system we investigate essentially the conditions of polymorphic inversion of kyanite/sillimanite etc., but natural sillimanite is often quite independent of other polymorphs in its formation and mostly forms by reactions involving micas. For the formation of such polymorphs, formed at different conditions in respect of temperatuıe and pressure, there must have been a different mechanism effected by chemical gradient and such highly mobile components as water, fluorine, boron etc.

The observations of Read on the depletion of sillica in the high-alumina pelitic schists immediately adjacent to the quartz-kyanite veins were explained as a process of solution and recrystallisation of the two-component minerals through the medium of an aqueus fluid. The veins and the adjoining rocks rich in kyanite were regarded as complementary products of differentiation (Read 1933).

Acknowledgements: Sincere thanks are due to Mr. Roy Phillips and Prof. G. M. Brown for the offer of X-ray and other laboratory facilities at the University of Durham during the author's visit there as a Nuffield Foundation Fellow. Thanks are also due to Prof. H. Strunz, Director, Krystall-mineralogisches Institut, Technical University, Berlin for the offer of facilities in crystallographic and Laser microprobe work during the author's stay at his Institute. Dr. A. K. Saha and Dr. A. K. Banerjee of Presidency College, Calcutta kindly revised the script. The author expresses his sincere gratitude to them.

References

ALDERMAN, A. R , (1942) Sillimanite, Kyanite and Clay deposits near Williamstown, South Australia, *Trans. Roy. Soc. South Australia*, v. 66, p. 3.

BANERJEF, A. K., (1954) 'On a Kyanite pegmatite from Ghagidih, Singhbhum Dt., Bihar.' *Science and Culture*, v. 20, pp. 241-242, 1929.

CLARK, (1961) A redetermination of equilibrium relations between Kyanite and sillimanite. *Am. Jr Sci* , v. 259, p. 641.

DUNN, J. A., (1942) *Mem. Geol. Surv., India*, 69 (2), 443.

HALLER, (1962) Structural control and regional metamorphism in the East Greenland Caledonides. *Proc. Geol. Soc. London*, no. 1594, pp. 21, 31.

HILLS, E. S., (1938) *Geol. Mag.*, *75*, pp. 296-304.

KOSTOV, I., (1960) The genesis of Kyanite in quartz veins. *Int. Geol. Rev* , v. 3, p. 645.

MIYASHIRO, A., (1951) Kyanites in druses in Kyanite-quartz veins from Saiho-ri in the Fukushinzan district, Korea, *Jr. Geol. Soc. Japan*, v. 57, p. 59.

NICHOLSON, (1964) The structure and metamorphism of the mantling Karagloe-Ankolean sediments of the Ntungamo gneiss dome and their time relation to the development of the dome. *Proc. Geol, Soc. Lond.*, no. 1613, p. 25.

READ, H. H., (1933) 'On quartz-kyanite rocks in Unst, Shetland, Islands. *Min. Mag* , v. 23, pp. 317-328.