Aspidolite $NaMg_3(Si_3Al)O_{10}(OH)_2$

Crystal Data: Triclinic or monoclinic. *Point Group*: $\bar{1}$ or 2/*m*. Interleaved with and rimmed by phlogopite plates to 1.2 mm, as aggregates of platy crystals.

Physical Properties: *Cleavage*: Perfect on {001}. *Tenacity*: Elastic. *Fracture*: n.d.
Hardness = 2-3 (by analogy to phlogopite). D(meas.) = n.d. D(calc.) = 2.885

Optical Properties: Translucent. *Color*: Light brown, olive green. *Streak*: White. *Luster*: Pearly.
Optical Class: Biaxial (-). Positive elongation. *Orientation*: $Z \parallel$ cleavage.
Pleochroism: X = colorless to yellow, $Y = Z$ = pale yellowish brown.

Cell Data: *Space Group*: $C\bar{1}$. $a = 5.289(6)$ $b = 9.16(1)$ $c = 9.892(9)$ $\alpha = 94.45(9)°$ $\beta = 97.74(9)°$ $\gamma = 90.0(1)°$ $Z = 2$ (1*A*); *C*2/*m*. $a = 5.291(8)$ $b = 9.16(2)$ $c = 10.12(2)$ $\beta = 105.1(1)°$ $Z = 2$ (1*M*)

X-ray Powder Pattern: Kasuga-mura, Gifu Prefecture, central Japan.
(polytype 1*A*) 2.62 (100), 9.73 (80), 4.57 (40), 3.26 (40), 2.55 (30), 2.45 (20), 3.46 (10)
(polytype 1*M*) 9.77 (100), 2.61 (100), 3.26 (50), 4.59 (25), 2.55 (25), 2.45 (20), 2.19 (20)

Chemistry:

	(1)		(1)
SiO_2	37.0	Na_2O	6.79
TiO_2	0.96	K_2O	0.97
Al_2O_3	22.7	F	0.16
FeO	4.12	H_2O	[4.26]
MgO	22.1	Total	99.0
CaO	0.04		

(1) Kasuga-mura, Gifu Prefecture, central Japan; electron microprobe analysis, H_2O calculated for OH+F+Cl = 2.0 a.p.f.u.; corresponds to $(Na_{0.90}K_{0.10})_{\Sigma=1.00}(Mg_{2.27}Al_{0.41}Fe^{2+}_{0.23}Ti_{0.05})_{\Sigma=2.96}(Si_{2.56}Al_{1.44})_{\Sigma=4.00}O_{10}[(OH)_{1.97}F_{0.03}]_{\Sigma=2.00}$.

Polymorphism & Series: Polytypes 1*A* and 1*M*; limited series with phlogopite.

Mineral Group: Mica group.

Occurrence: In thermally metamorphosed rocks (greenschist to amphibolite facies) in the contact aureole of a granite; in metamorphosed evaporite rocks (Algeria); from norite xenoliths (Chile); as inclusions in chromites of mafic layered intrusions and ophiolite complexes (China).

Association: Phlogopite, pargasite, magnesiosadanagaite, titanite, calcite, scapolite, apatite, pyrrhotite, chalcopyrite, chlorite, pyrite (Kasuga-mura, Japan); enstatite, spinel (China).

Distribution: From Derrag, Tell Atlas, Algeria and Volcán San Pedro, Andes Mountains, Chile. From the dumps of Kawai pit, Kasuga-mura, Gifu Prefecture, central Japan. From Zillertal, Tyrol, Austria. In the North Qilian Mountains, Qinghai Province, northwestern China.

Name: From the Greek "aspida" for "a shield" and "lithos" for "stone", alluding to the crystal habit.

Type Material: Geological Museum, Geological Survey of Japan, AIST, Tsukuba (M35151-4) and at the National Science Museum, Tokyo (NSM-28719), Japan.

References: (1) Banno, Y., R. Miyawaki, T. Kogure, S. Matsubara, T. Kamiya, and S. Yamada (2005) Aspidolite, the Na analog of phlogopite, from Kasuga-mura, Gifu Prefecture, central Japan: description and structural data. Mineral. Mag., 69(6), 1047-1057. (2) Kogure, T., Y. Banno, and R. Miyawaki (2004) Interlayer structure in aspidolite, the Na analogue of phlogopite. Eur. J. Mineral., 16, 891-897. (3) Schreyer, W., K. Abraham, and H. Kulke (1980) Natural sodium phlogopite coexisting with potassium phlogopite and sodian aluminian talc in a metamorphic evaporite sequence from Derrag, Tell Atlas, Algeria. Contrib. Mineral. Petrol., 74, 223-233. (4) Costa, F., M.A. Dungan, and B.S. Singer (2001) Magmatic Na-rich phlogopite in a suite of gabbroic crustal xenoliths from Volcán San Pedro, Chilean Andes: Evidence for a solvus relation between phlogopite and aspidolite. Am. Mineral., 86, 29-35. (5) Tseng, Chien-Yuan, Houng-Yi Yang, Han-Quan Wu,

and Guo-Chao Zuo (2007) The silicate mineral inclusions in the chromian spinel from the Dongcaohe Ophiolite, North Qilian Mountains, Northwestern China: record of syntaxis of lower oceanic crust. Can. Mineral., 45, 793-808.