Butianite Ni_6SnS_2

Crystal Data: Tetragonal. *Point Group*: 4/*m* 2/*m* 2/*m*. As irregular grains to 8 μm.

Physical Properties: *Cleavage*: n.d. *Fracture*: n.d. *Tenacity*: n.d. Hardness = n.d.
D(meas.) = n.d. D(calc.) = 7.62

Optical Properties: Opaque. *Color*: n.d. *Streak*: n.d. *Luster*: n.d.
Optical Class: n.d.

Cell Data: Space Group: *I*4/*mmm*. *a* = 3.65 *c* = 18.14 Z = 2

X-ray Powder Pattern: Calculated pattern.
4.535 (100), 1.825 (38), 1.693 (30), 1.963 (14), 3.024 (12), 1.291 (12), 1.241 (11)

Chemistry:

	(1)	(2)
Ni	62.1	65.83
S	8.9	11.99
Ge	5.3	
Te	10.3	
Sn	11.1	22.18
Fe	1.3	
Total	99.1	100.00

(1) Allende CV3 carbonaceous chondrite meteorite; average of 4 electron microprobe analyses; corresponds to $(Ni_{5.93}Fe_{0.13})_{\Sigma=6.06}(Sn_{0.52}Ge_{0.41})_{\Sigma=0.93}(S_{1.56}Te_{0.45})_{\Sigma=2.01}$. (2) Ni_6SnS_2.

Occurrence: Very late-stage, vapor-deposited, alteration product in veins and as mono-mineralic crack-filling material in igneous diopside in the Type B1 Ca-Al-rich inclusion (CAI) *ACM-2* from the Allende CV3 carbonaceous chondrite.

Association: Al-Ti-rich diopside, nuwaite, heazlewoodite, Ge-bearing Ni-Fe alloy, possibly monticellite.

Distribution: From the Allende CV3 carbonaceous chondrite meteorite.

Name: After the Chinese words "Bu Tian," meaning *patching the sky*, in allusion to this secondary mineral filling cracks in a primitive refractory inclusion in the early solar system.

Type Material: National Museum of Natural History, Washington, D.C., USA (7616).

References: (1) Ma, C. and J.R. Beckett (2018) Nuwaite (Ni_6GeS_2) and butianite (Ni_6SnS_2), two new minerals from the Allende meteorite: Alteration products in the early solar system. Amer. Mineral., 103(12), 1918-1924.