

## **Structural rationale for twinning in galena and a possible relation with the lillianite homologous series**

**MASSIMO NESPOLO<sup>1,\*</sup> AND MAHAMADOU DIALLO<sup>1</sup>**

<sup>1</sup>Université de Lorraine, CNRS, CRM2, 54000, Nancy, France

### **ABSTRACT**

Two reflection twins are known in the literature for galena: on {111} (spinel twin), frequent, and on {114}, rare and lamellar. The galena structure is highly pseudo-symmetric with respect to a reflection about {111}: at the composition plane, the lead and sulfur coordination change from octahedral to trigonal prismatic, without modification of the bond distances but with a shrinkage of the non-bonding Pb-Pb and S-S distances. The coordination around the composition plane of the {114} twin is instead broken, with too short non-bonding Pb-Pb and S-S distances and empty regions that justify the rarity of this twin. The composition plane is, however, highly reminiscent of the interface between galena modules in the lillianite homologous series, although the cell-twin operation active in that case is a reflection on a different plane, {113}. In lillianite and related structures of the PbS-Bi<sub>2</sub>S<sub>3</sub> phase diagram, coalescence of Pb sites corresponding to too short non-bonding distances allows for partial heterovalent Pb<sup>2+</sup>-Bi<sup>3+</sup> substitution. Given the similarity of the composition plane of the {114} twin, structural adjustments, possibly with a role played by impurities, may explain the formation of this twin, whose lamellar nature is also reminiscent of the polysynthetic cell-twinning in the lillianite homologous series. Because the {114} twin was only reported in previous morphological investigations and was never confirmed by diffraction studies, the hypothesis that this rare twin may actually correspond to {113}, i.e., the macroscopic counterpart of the well-known homologous series obtained by cell-twinning on the same plane, cannot be ruled out. The relative orientation of the twinned crystals of the two twins is, however, too different to support this hypothesis.

**Keywords:** Galena, interface, lillianite, pseudo-symmetry, twinning