VanTongeren and Mathez (2012) suggested that there are two (300-m-thick) different units comprising the uppermost rocks of the eastern Bushveld Complex (South Africa), derived from immiscible liquids. Their argument hinged on the rare earth element (REE) abundance of apatite, claiming “a distinct geochemical break” (p. 491). I questioned the abruptness of this break (Cawthorn, 2013), to which it was admitted that “there is one transitional sample (at 355 m)” (VanTongeren and Mathez, 2014). Much therefore depends on the rate of change of REEs through this transitional interval. The upper boundary to their lower layer occurs 5 m above the top magnetitite layer (layer 21). There exists a comprehensive database on REE contents in apatite from a borehole, BK1, in the western Bushveld (Geraghty, 1994) for the same interval. In Figure 1, Ce contents in apatite are scattered but show a gradual upward increase from 400 ppm (base) to 1800 ppm (top). The Eu/Eu* shows a gradual (again erratic) decrease from 1.0 to 0.4. These values are closely comparable to those of Van Tongeren and Mathez (2012), and there is no distinct break. Thus, I question the geochemical evidence for distinct layers. If it is assumed that these mineral compositions represent the true cumulus compositions, then the liquids that produced these minerals must have varied in exactly the same way as the mineral compositions in Figure 1 (but multiplied by the partition coefficient), leading to the implied consequence that the liquid changed abruptly and erratically as this sequence formed. Such apparent variations in evolving liquid composition become resolved if the trapped liquid effect is considered. There is one point on the Ce plot that appears aberrant (at 893 m), having 1344 ppm Ce. Whole-rock analyses for phosphorus showed that almost all these rocks contained over 1% apatite. Sample 893 contained only 0.2% apatite. Due to the low modal abundance, the final concentration in apatite was markedly increased as a result of the trapped liquid shift effect, as predicted by my calculations (Cawthorn, 2013). VanTongeren and Mathez’s (2014) specific objections to my calculations can be reassessed. They challenged my use of phosphorus contents in whole rock to determine proportion of apatite. I suggest that whole-rock analyses produce a much better estimate than point counting for minerals in very low abundance. They claim my estimate of 2% apatite in the liquid was “unconstrained,” but it was based on the experimental data of Green and Watson (1982). VanTongeren and Mathez (2012, p. 494) stated “The lack of Eu anomaly in the Bushveld apatite-magnetite-rich rock, and more generally in nelsonites, remains unexplained.” This issue requires further research, perhaps including a larger database of apatite partition coefficients for Eu<sup>2+</sup> and Eu<sup>3+</sup> in melts of different composition, as alluded to by VanTongeren and Mathez (2014).

REFERENCES CITED


