Comments on “The Applicability of Dual Gamma Scanning to Freezing Soils and the Problem of Stratification”

Goit et al. (1978) presented an interesting paper on the use of dual-energy gamma-ray techniques in freezing soils. Because of the nature of their results, a considerable amount of attention was devoted to specifying instrumentation used, comparing it to that of Nofziger and Swartzendruber (1974), and identifying important aspects in the design of dual-energy systems. I would like to mention additional differences between the dual-energy systems of Goit et al. (1978) and Nofziger and Swartzendruber (1974) which I believe are significant in the operation of such instruments.

The enabling crux of the composite-beam dual-gamma method is the material-independent relation $e(i_s)$ first reported by Nofziger and Swartzendruber (1974), where $e$ is the measured intensity in the Am window due to Cs, and $i_s$ is the measured intensity in the high-energy Cs window. Figure 2 of Nofziger and Swartzendruber (1974) shows that $e(i_s)$ was slightly curvilinear but very nearly a proportional relationship, with $e$ about 10% of $i_s$. In contrast, Figure 1 of Goit et al. (1978) yielded $e$ of at least 50% of $i_s$. The measured intensity in the Am window due to scattering within the detector crystal suggests that the 5.1 by 5.1 cm crystal used by Nofziger and Swartzendruber (1974) is preferable to the 1.27 by 3.4 cm crystal used by Goit et al. (1978). A thorough investigation of the optimum crystal size for detecting dual-energy gamma rays seems worthwhile.

Another significant difference in the two dual-energy systems is the intensity due to Am itself. Goit et al. (1978) state that a typical count rate for Am was $6.5 \times 10^4$ cpm, while Nofziger and Swartzendruber (1976) had count rates (correcting for Cs) ranging from $54 \times 10^4$ to $33 \times 10^4$ cpm. The higher count rates for Nofziger and Swartzendruber were obtained through a soil column 6.28 cm in diameter, instead of 3.7 cm as used by Goit et al. (1978). The use of a larger soil column allows for a more accurate measurement of Am intensity.