

More on the Uniqueness of Gunshot Residue (GSR) Particles

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ABSTRACT: The question of “accepted uniqueness” of several types of GSR particles is discussed. Based on our experience, we propose to include GSR particles formed in firing the Sellier Bellot, Prague (SBP) ammunition in the group of “unique” GSR particles. With the advent of autosearch systems for GSR analysis in crime labs, a better statistical basis for the extent of uniqueness of various types of GSR particles may be achieved.

KEYWORDS: forensic science, gunshot residue, SBP ammunition, uniqueness

In their pioneering extensive study, Wolten et al. (1–3) proposed a classification scheme for GSR. They divided GSR into two categories: (a) unique or characteristic, (b) consistent.

The unique or characteristic category, according to the above mentioned study, included the following compositions: (a1) lead, antimony and barium, (a2) barium, calcium and silicon with a trace of sulfur, (a3) barium, calcium and silicon with a trace of lead if copper and zinc are absent, and (a4) antimony and barium.

Their definition of unique was based on the experimental fact that those compositions have thus far been observed only in GSR. Particularly it was based on their examination of about 80 hand samples from people whose occupation involved the metals or compounds of lead, barium and antimony. In those samples, particles in the (a) category have not been found. The compositions in the consistent or (b) category, like lead and antimony or lead and barium, have been found by Wolten et al. in few occupational residues and therefore those compositions have been defined only as consistent but not unique.

This classification scheme has been adopted in general by the forensic experts dealing with GSR analysis (Personal communications, FBI Seminar on GSR Detection and Analysis, August 13–16, 1989, Quantico, VA, USA, and Forensic Science Symposium, June 15–17, 1992, Linkoping, Sweden). However, the definition “unique” to describe material compositions should be applied cautiously.

Even in the field of fingerprint identification or toolmarks comparison, where the experimental basis for uniqueness is much more extensive and is consistent with probability theory models, there is a problem to assess quantitative criteria to decide when a particular pattern becomes unique (4–6). Certainly the situation is not any easier when such a conclusion concerns chemical compositions.

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Particularly, there are no theoretical restrictions on compositions in the (a) category which restricts its origin to primer discharge. Actually, Wallace and McQuillan (7) reported several cases which indicated that the composition (a2) was unlikely to have originated from primer discharge. From our casework experience the same applies to composition (a3). Also, Wolten and al., asserted that they have not found compositions of category (a) in stud gun residues. However, as has been reported later (7), compositions (a1) and (a4) are characteristic to discharge of the Obo SG75 (Societe Outifix, Gevelot) cartridges, and we have found these compositions also in the Fiocchi, Italy (GFL) cartridges for stud guns too.

We propose to include an additional composition in the classification scheme of gunshot residues mentioned above. The characteristic particles' composition: lead, barium, calcium, silicon and tin, formed in discharge of 9 mm and 7.65 mm Sellier Bellot, Prague (SBP) ammunition (8) (Fig. 1) should be included, in our opinion, in the (a) category. This proposition is based on our seven years of computerized casework experience starting in the year 1989 (9).

In this period we have examined 1211 samples (778 suspects in 482 cases) using an automated search system attached to a CamScan 4 SEM equipped with a motorized stage drive and a four-samples holder, combined with a Tracor-Northern TN 5500 EDX system. Most of the samples were from hands, hair and the clothing of suspects. Twelve of these cases contained SBP cartridges recovered from the crime scene. In three of them particles characteristic of the SBP ammunition, containing lead, barium, calcium silicon and tin, were identified. In every case where SBP GSR particles were identified, the recovered cartridge cases were of SBP. It should be pointed out that in every autosearch run, the system will detect and classify (among others) the SBP composition either in the category Pb, Ba or in the category Pb, Ba, Sb. Therefore in every autosearched sample we would examine manually every particle that could have the characteristic composition of SBP which the system detected. It is worthwhile to add, that in every run, several hundred particles are classified on average by the system. Thus in the period of seven years, we can say that several hundred thousand particles have been examined and classified in various samples, and characteristic particles of SBP have been found only in 3 cases (out of 12) in which SBP ammunition cartridges were found at the scene of crime. In addition, Wolten et al. (1–3) have not found this composition among environmental or occupational particles which are close in composition to GSR.

Therefore, in our opinion the experimental data base is extensive enough to conclude that the “uniqueness” of SBP GSR composition is not less than that of the compositions Pb, Ba and Sb, or Sb and Ba. It was pointed out by Stoney (10) that it is not possible to reach uniqueness through statistics. Nevertheless, with the advent of autosearch systems for GSR in numerous crime labs, it may be

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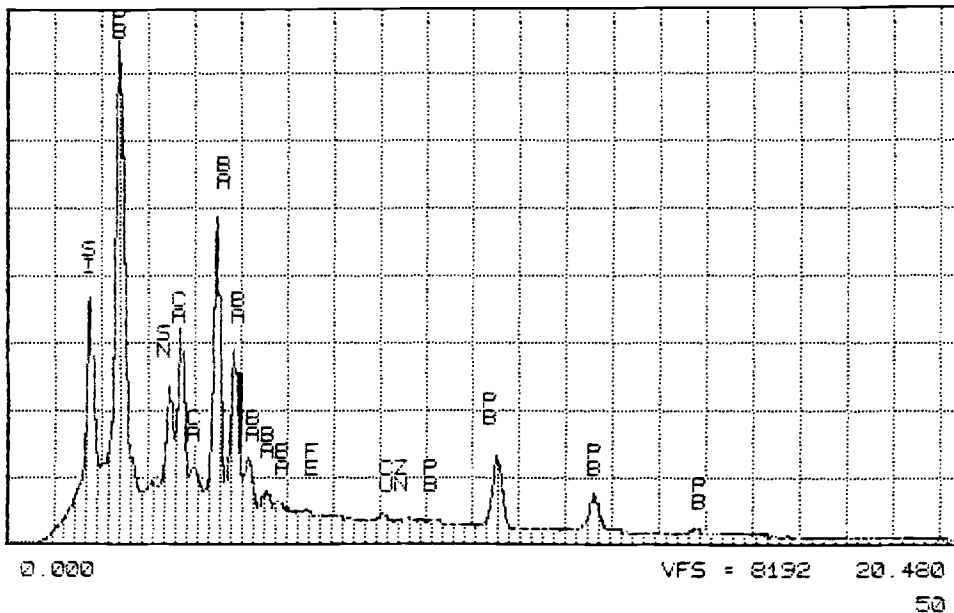


FIG. 1—EDX spectrum of a characteristic GSR particle from 9-mm SBP ammunition.

much easier than before (using manual search), to assess experimentally the extent of uniqueness of various GSR compositions in a similar manner as the contribution of automated systems for fingerprint and firearms identification.

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