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J. D. L. White · J. McPhie · I. Skilling

Peperite: a useful genetic term

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Introduction

Recent years have seen increasing documentation of rocks termed peperites, and the bulk of these rocks are inferred to have developed along the margins of intrusions into unconsolidated wet sediment. Herein we provide a genetic definition of the term "peperite" and argue against its use in a descriptive sense.

Use of the term "peperite"

The genetic use of the term "peperite" can be succinctly summarized: peperite(n): *a genetic term applied to a rock formed essentially in situ by disintegration of magma intruding and mingling with unconsolidated or poorly consolidated, typically wet sediments.* The term also refers to similar mixtures generated by the same processes operating at the contacts of lavas and hot pyroclastic flow deposits with such sediments.

The foregoing genetically based definition can be contrasted with another use of the term, which is as a descriptor of any rock which consists of a mixture of sedimentary and igneous components. Peperite as a descriptive term is rooted in etymology and historic usage, but is arguably less functional and overlaps with other established nomenclature. The term "peperite" was coined (Scrope 1858) for a limestone–basalt mixture, the origin of which has since been much debated. Scrope's own wording, such as "...bearing equally the appearance of a violent and intimate union of volcanic fragmentary matter with limestone while yet in a soft state" (p. 21), is ambiguous with respect to precise origin. Michel-Levy (1890) proposed an intrusive origin and it is this interpretation that underlies the definition presented herein. Jones (1969) regarded Scrope's original interpretation as indicating a mixture clearly formed by pyroclastic fall into lime mud, an interpretation with which he concurred. Jones' (1969) interpretation was recently reconfirmed by De Goer et al. (1998) who argued against the genetic use of "peperite" because of its association with a deposit formed by other processes. Other authors have recently suggested a return to the descriptive use, based on historic precedent and perceived difficulties in establishing the genesis of particular examples of such mixtures (Cas et al. 1998). Rather than approaching this issue from the standpoint of etymology, historical usage, or current favor, we argue that the Scropes-based genetic definition should be consistently adopted for the following reasons.

The genetic use of the term "peperite" recognizes that a specific set of processes is involved, and no other term is applicable to deposits formed by these processes. As defined herein, peperite forms where magma encounters unconsolidated, typically wet, sediments. "Magma" is used herein to include any molten material, whether intruded, effused as lava, or fused from pyroclasts. Mingling accompanies fragmentation and occurs as a result of magma movement and/or sediment movement induced primarily by heat transfer. Thus defined, the rock carries information on relative timing of magmatism and sedimentation, on the flow and fragmentation processes of magma, and on the rheology of the host sediment.

Well-founded criteria exist for identification of peperite, as genetically defined. The range of behavior

Editorial responsibility: C.G. Newhall

James D. L. White (✉)
Department of Geology, University of Otago, P.O. Box 56, Dunedin, New Zealand
james.white@stonebow.otago.ac.nz

Jocelyn McPhie
Centre for Ore Deposit Research, University of Tasmania, Hobart, Australia

Ian Skilling
Department of Geology, Rhodes University, Grahamstown, South Africa

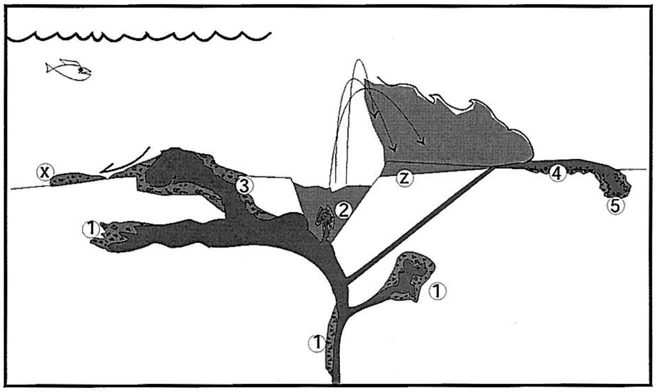

Fig. 1 Schematic illustration of common sites of peperite development associated with: (1) dikes and other intrusions; (2) feeder dikes intruding vent-filling deposits; (3) partly-emergent intrusions; (4) bases of lavas; (5) margins of invasive lavas. Other deposits, which are not considered peperites, are (x) slump or density current deposit derived from peperite; (z) fallout and pyroclastic density current deposits from explosive phreatomagmatic eruptions; lahar deposits (not shown)

resulting from the contact of magma with unconsolidated sediment remains a focus for ongoing research. Nevertheless, characteristic features are: the close spatial association with and gradation into unmixed coherent intrusions or lavas of the same composition and texture as the igneous clasts; induration of the sediment component where in contact with the igneous component; disruption or destruction of sedimentary structures in the sediment component; and partial or complete chilling of the igneous component in contact with the sediment. Furthermore, peperite is typically non-stratified, ungraded, and may be highly discordant to bedding.

Adequate descriptive terms already exist for rocks which consist of a mixture of sedimentary and igneous components. For instance, a rock of uncertain origin which comprises a mixture of quartz and subordinate basalt sand can be termed a "(basalt-)lithic-rich quartzose sandstone" and one of unknown origin which consists of coarse clasts of basalt in a non-basaltic matrix, a basaltic volcanic breccia (Schmid 1981; Fisher and Schmincke 1984; Cas and Wright 1987; McPhie et al. 1993). Most peperite (as summarized in our opening restatement of the term as a genetic one) can be described using terms that include the names for the clastic and igneous components, the grain size, and/or a lithofacies characteristic, e.g., massive mudstone–basalt breccia or poorly sorted siltstone–rhyolite breccia.

All other origins of rocks which consist of both igneous and sedimentary components involve fragmentation and mixing mechanisms for which genetic terms already exist. A wide range of sedimentary and volcanic processes can produce mixtures of igneous and sedimentary clasts. These other origins involve different mechanisms of magma fragmentation and timing relationships that are different from those involved in formation of peperite. Plausible scenarios include for example:

1. Infiltration of sediment into an open framework autoclastic breccia (e.g., hyaloclastite or autobreccia) or pyroclastic breccia (e.g., coarse fallout deposit)
2. Fallout of juvenile pyroclasts into unconsolidated sediment
3. Water-settled fallout of juvenile pyroclasts contemporaneous with hemipelagic or mass-flow sedimentation
4. Mixing of juvenile pyroclasts with non-juvenile sediment in base surges and pyroclastic flows
5. Syneruptive or posteruptive collapse of lavas or domes emplaced onto unconsolidated sediment or tephra
6. Resedimentation of autoclastic or juvenile pyroclastic deposits by sedimentary mass-flow processes such as lahars

In summary, peperite is an appropriate genetic term for an identifiable facies type formed by a specific set of processes which otherwise lacks a name. Correct identification of peperite is important in indicating nearly contemporaneous sedimentation and magmatism, and in distinguishing lavas, which may have basal peperite but not upper-contact peperite, from intrusions, including those originating as invasive lavas (e.g., Schmincke 1967). Non-genetic use of the term is unnecessary because nomenclature for describing all such mixtures, regardless of origin, is already available. Such non-genetic terms should indeed be applied in all cases until an interpretation of genesis is made based on field and textural studies.

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