



# Building and ornamental use of trachyte in the center of France during antiquity: Sources and criteria of identification



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## ABSTRACT

The volcanic field of Chaîne des Puys (French Massif Central) includes six trachytic volcanoes, the lavas of which were more or less extensively exploited during antiquity and medieval ages as a raw material for construction, sculpture and fabrication of sarcophagi. Recent questioning on the origin of trachytes from the famous Mercury sanctuary (2nd centuries AD) built atop Puy de Dôme volcano motivated the launch of a program devoted to establish source identification criteria for trachytic artifacts based on petrography, geochemistry and mineralogy. These analyses allowed to establish a list of very strong criteria allowing to distinguish each volcano. The nature of the minerals being discriminating in most cases, a small sample size is sufficient for the diagnosis.

The possibilities offered by the new classification are illustrated by a reappraisal of trachyte supplying around *Augustonemetum* (Clermont-Ferrand) during the Gallo-Roman period. In the course of this program, we discovered a previously unknown major quarry of trachyte.

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## 1. Introduction

The Chaîne des Puys (French Massif-Central) is a small intraplate linear volcanic field, comprising about 80 monogenic volcanoes (Boivin et al., 2009; Boivin and Thouret, 2013) erupted between about 100,000 and 8600 years ago. Seven of the volcanoes are trachytic, namely Puy Chopine, Grand Sarcoui, Cliersou, Aumône (also named Petit Suchet), Puy de Dôme, Kilian and Vasset (Fig. 1).

Trachytic lavas of the Chaîne des Puys – still sometimes denominated with the ancient name *domite* – are generally light gray to dark gray, with low density (1300 to 2200 kg·m<sup>-3</sup>) and poor resistance to compression (0 to 55 MPa) (Auzanneau and Héritier, 2010). Although some of them are altered by frost (Kieffer, 2003), trachytes have been used in the far past for building and ornamental purposes because they can easily be extracted and cut. The local use of trachyte during antiquity is evidenced by the ruins of a famous major temple dedicated to Mercury (2nd centuries AD, Fig. 2) atop Puy de Dôme volcano (Paillet et al., 2003; Gély et al., 2008), by the ruins of a Gallo-Roman urban area at Col de Ceysat, immediately south of the Puy de Dôme (Trément et al., 2003; Dousteysier, 2011), and by numerous findings

of various Gallo-Roman trachytic artifacts in the Limagne plain in the vicinity of Clermont-Ferrand, formerly city of *Augustonemetum*.

Trachyte has also been extensively used for the production of sarcophagi during the Merovingian period (5th–8th centuries AD), out of the scope of the present work. In addition, ancient, mostly subterranean quarries for trachyte extraction have been known for a long time in the upper part of certain trachytic volcanoes (e.g., Lecoq, 1867; Fournier, 1973).

This context is very favorable to develop studies focused on the economical use of trachytic stones during the past, because it meets prerequisites made by archeologists involved in this field (e.g., Bessac and Sablayrolles, 2002a,b). This question has been studied for a long time (Atzori et al., 1996). Taking advantage of the increased number of rock characterization methods, many recent studies have expanded the scope of applications and the reliability of results (Malfilatre et al., 2014 and references therein). Also, our research takes advantage of the characteristics of the Chaîne des Puys: the number of sources is limited, quarries are well preserved and their potential archeological content is important, in the most cases trachyte types sufficiently differ from each other to enable identification and, finally, trachyte is very abundant in two major sites (temple of Mercury and Col de Ceysat urban area). Actually, the link between a given quarry and a given use has been assumed for a long time (Brunhes, 1906; Gély et al., 2008), but in 2007 the resumption of archeological excavations atop the Puy de Dôme revealed the existence of an unknown facies of trachyte that incited us to search its origin. So, we developed a program aimed at

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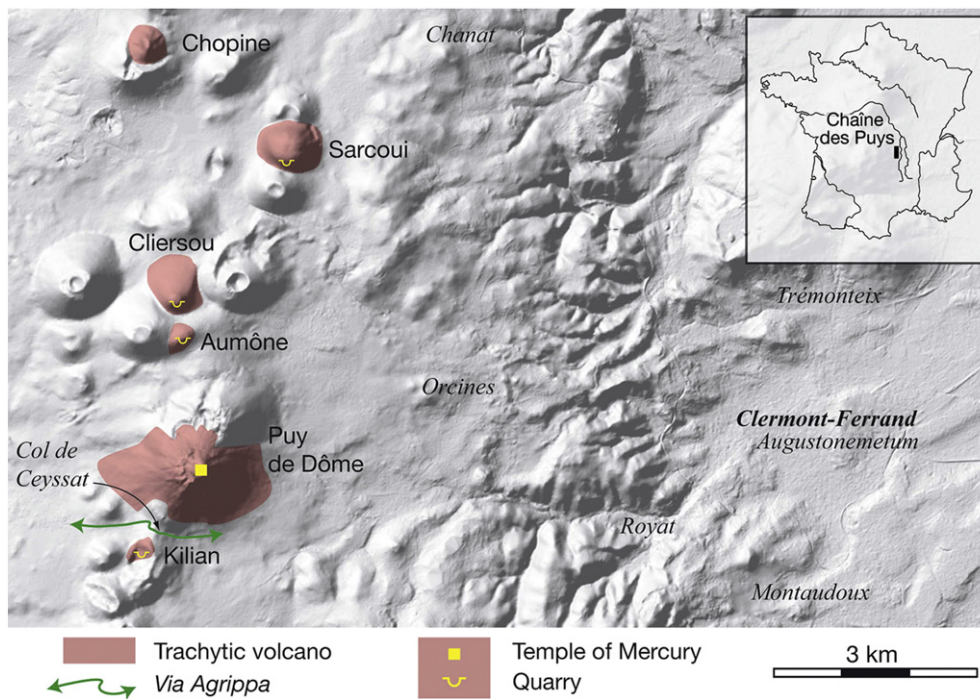


Fig. 1. Trachytic volcanoes and known quarries in the Chaîne des Puys. The unexploited Puy Vasset is located 1 km southward, out of the map.

establishing and testing criteria of identification for all the trachytic resources.

Section 2 of the present paper summarizes the main features of the volcanoes of interest. Section 3 presents the methods used for characterizing the different trachytes and gives the petrographical, mineralogical and chemical criteria, necessary and sufficient to distinguish them.

In Section 4, the possibilities offered by the new classification are illustrated by reappraising the provenance of trachytes used during the Gallo-Roman period, particularly at the temple of Mercury and its close vicinity.

## 2. Trachytic resources: volcanoes and quarries

No outcrop of massive lava has ever been observed on Vasset volcano (Boivin et al., 2009), so only six of the seven cited volcanoes can have



Fig. 2. Ruins of the temple of Mercury atop Puy de Dôme volcano. All white building stones are made of the same trachyte (photograph dated 1874, Archives Départementales du Puy-de-Dôme, 154Fi-13).

been exploited for massive trachyte. Grand Sarcoui, Puy de Dôme, Aumône and Cliersou are domes formed by accumulation of viscous lava over a vent. Puy Chopine is a protrusion, a sort of gigantic plug made by lava with such a high viscosity that it could not spread out laterally. Kilian was probably initiated as a dome encased in the older Strombolian cone of Grosmanaux (van Wyk de Vries et al., 2014), but the dome was violently destroyed by a final explosion. Today, Kilian has the morphology of a hollow tooth, with remains of massive lava crowning half of the so-called Kilian crater.

Typically, massive trachyte crops out on the upper half of the volcanoes (Fig. 3), except for Kilian in which it is only attainable in the internal flanks of the crater.

The lower flanks of the volcanoes are covered by thick layers of blocks and ashes deposited from pyroclastic flows, and to a lesser extent, from later erosion. Also, some domes are partially covered by layers of tephra spread out from neighboring younger volcanoes. Localized variations of the texture and aspect of the trachyte may occur within a given volcano. These were induced during eruption, possibly due to small variations in magma composition, eruptive dynamics or cooling conditions. Alternatively, they may be a consequence of post-eruptive fumaroles or hydrothermal activity.

Old quarries for extraction of massive lava have been known for a long time near the summit of Aumône, Cliersou (Fig. 3) and Grand Sarcoui (e.g., Lecoq, 1867; Fournier, 1973), while none are yet known at Puy Chopine (Fig. 1). A minor site of extraction of massive trachyte has been discovered in 2014 on the southern flank of Puy de Dôme and a small quarry, currently masked by a modern building, was represented atop the volcano on a 1875 watercolor map (Bruyère, 1875). Quarries, nowadays felt into disuse, were also installed in block-and-ash flow deposits at the bottom of Puy de Dôme. In such deposits, the exploitation was limited by the availability of large blocks of massive lava. The quarries at the Kilian crater were discovered in 2008 within the framework of this work (Miallier et al., 2013), although they have significantly modified the initial morphology of the crater.

No thorough archeological study has ever been performed in any quarry, but for a few limited soundings in Kilian (Miallier et al., 2013). In most of the quarries, the production of sarcophagi during the Merovingian period is clearly evidenced by in situ marks of extraction and

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