

A HISTORIC TURQUOISE JEWELRY SET CONTAINING FOSSILIZED DENTINE (ODONTOLITE) AND GLASS

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A set of six antique brooches, set with diamonds and light blue cabochons, was investigated with microscopy, Raman analysis, and EDXRF spectroscopy. Most of the cabochons proved to be fossilized dentine, also known as odontolite (mineralogically, fluorapatite). The brooches also contained turquoise and artificial glass.

The Swiss Gemmological Institute SSEF recently received a set of six antique brooches for identification (figure 1). These same pieces had already been presented in Bennett and Mascetti (2003, p. 102) as turquoise jewelry. They were set with numerous small rose-cut diamonds and a few larger old-cut diamonds, but most prominent were a number of light blue to greenish blue cabochons that appeared to be turquoise. Visual examination quickly revealed otherwise. Considering the historic background of these brooches, we were interested in examining the blue gems in greater detail to shed light on early turquoise imitations.

Turquoise, a copper-bearing hydrated aluminum phosphate with the chemical formula

$\text{Cu}(\text{Al,Fe}^{3+})_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$, has been known since prehistoric times. It has been widely used in jewelry in the Middle East (Egypt and Persia), the Far East (Tibet, Mongolia, and China), and by native North Americans (Ahmed, 1999; Chalker et al., 2004). Yet turquoise was once very fashionable in Europe, especially during the 18th and 19th centuries (Bennett and Mascetti, 2003), so it is not surprising that imitations were used when genuine turquoise was not available. The wide range of turquoise imitations includes secondary minerals from copper deposits such as chrysocolla, dyed minerals such as magnesite or howlite, and artificial materials such as glass or sintered products (Arnould and Poirot, 1975; Lind et al., 1983; Fryer, 1983; Kane, 1985; Hurwit, 1988; Salanne, 2009).

In this study, we report on a historic turquoise substitute—fossilized dentine, also known as *odontolite*, *ivory turquoise*, *bone turquoise*, or *French turquoise*. Much of this material consists of fossilized mastodon ivory from Miocene-age (13–16 million years old) sedimentary rocks of the Gers District between the Aquitaine and Languedoc regions of southwestern France (Reiche et al., 2001). The tusks are hosted by alluvial sediments (molasse alternating with fine sand and clay facies) that accumulated in basins during the erosion of the nearby Pyrenees Mountains (Crouzel, 1957; Antoine et al., 1997). The fossilized dentine consists mainly of fluorapatite, $\text{Ca}_5(\text{PO}_4)_3\text{F}$; since medieval times, local Cistercian monks have used a heating process to turn the material light blue (de La Brosse, 1626; Réaumur, 1715; Fischer, 1819), which they thought to be turquoise. These “stones” were originally set in medieval religious artifacts, but came into fashion in the early to mid-19th century (Brown, 2007),

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