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Case study

An interdisciplinary investigation on Daoist *Wushi* (五石, *five minerals*) unearthed from three tombs dated to the Eastern Han Dynasty (AD 25–220) in Xianyang City, China

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ABSTRACT

Daoist *wushi* (五石, *five minerals*) have been uncovered from archaeological sites in different regions in China and this has generated great interest amongst archaeologists, historians and Daoists. This paper presents an interdisciplinary study concerning groups of *wushi* found in three tombs dated to the Eastern Han Dynasty (AD 25–220), located in *Xianyang* city, Shaanxi province. The research analyzes *wushi* and discusses their identifications by using Raman spectroscopy, X-ray fluorescence and X-ray diffraction for the first time. The results indicated the presence of azurite, cinnabar, calcite, orpiment, realgar, magnetite, fluorite, crystal quartz, and sulfur, which is much more diverse than the conventional opinions of *wushi* held by historians and archaeologists in terms of Daoist literature. Meanwhile, it reveals that different minerals sometimes use the same name but without uniformity in their identification, which proves the uncertainty to distinguish *wushi* only by deciphering the archaeological inscriptions. In addition, the observation of *wushi* shows that their orientations in the tomb are not completely in accordance with the Five Phases theory derived from Daoism.

1. Introduction and research aims

In Daoist literature, *wushi* (五石, *five minerals*) are commonly regarded as five natural minerals, also translated as five rocks [1]. Their occurrence is proposed to be pertinent to the Five Agents or Five Phases, derived from Daoist beliefs. The Daoist teatise *Baopuzi* [Master Who Embraces Simplicity] mentions *wushi* are in blue, red, white, black and yellow colors and could serve as alchemical pills to acquire longevity or immortality [2]. Besides the written documentation, *wushi* were also excavated in ancient tombs [3,4], sometimes distributed in specific positions in the tomb, including east, south, west, north and centre, which is believed to have magic power and be capable of preventing the body and soul of the deceased from the tortures of the hells and benefiting his or her descendants [5]. Interestingly, by the time of the Eastern Han Dynasty (AD 25–220), *wushi*, sometimes less than five minerals, were particularly found in pottery vessels, called grave-quelling jars [6–9]. In addition, the meaning and ritual function of *wushi* is sometimes explained by red inscriptions written on the surface of the jars, termed as "grave-quelling script" or a "tomb ordinance" [10]. Such inscriptions were written by a religious professional to ensure the security of the deceased in the afterlife and to protect his or her living relatives, which is thought to reflect a particular view of the death during the Eastern Han. Table 1 presents some selected texts about *wushi* from historical literature and archaeological inscriptions on the pottery vessels. Table 2 summarized *wushi* in Chinese character, pinyin, literal translation into English, suggested minerals and specific orientations.

Although *wushi* generate a great deal of interest amongst archeologists, historians and Daoists, who identify them mainly by the observation of color, texture, shape and odour or according to historical literature, there is very little scientific investigation of these minerals unfortunately. *Wushi*, in terms of Daoist literature and

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Table 1
Wushi from historical literature and archaeological inscription.

Wushi recorded in literatures about their names and functions (general *wushi* and single *wushi*)	Inscriptions found on excavated pottery bottles from archaeological sites (general *wushi* and single *wushi*)
Baopuzi-Jindan (The Master Who Embraces Simplicity, Gold and Cinnabar [pill of immortality]) notes that ***wushi*** are ***dansha, xionghuang, baiyu, cengqing*** and ***cishi.*** (《抱扑子·金丹》邹: "五石者, 丹砂、雄黄、白礬、曾青、慈石也。") [2]	***Cengqing, xionghuang, dansha, yushi, cishi, wushi.*** ("曾青、雄黄、丹沙、礬石、慈石, 五石") [11]
According to *Taiqingshibiji* (Records in the Rock Chamber: a *Taiqing* Scripture), ***cengqing*** is the essence of Azure Dragon of the east, associated with wood phase; ***dansha***, is the essence of Vermilion Sparrow in the South, associated with fire phase; ***yushi,*** is essence of the White Tiger in the North, associated with metal phase; ***cishi***, is essence of black Xuanwu (a turtle with a snake slung around it) in the south, associated with water phase; ***xionghuang***, is essence of Yellow Dragon in the Center, associated with earth phase. (《太清石壁记》邹: "曾青者, 东方青帝木行青龙之精; 丹砂者, 南方赤帝火行朱雀之精; 白礬石者, 西方白帝金行白虎之精; 磁石者, 北方黑帝水行玄武之精; 雄黄者, 中央黄帝土行黄龙之精") [12]	By master of the Dao, essence of ***wushi*** will keep the tomb peace and benefit the offspring. ("要道中人, 和以五石之精, 安冢墓, 利子") [13]
Huannanwanbishu (The Ten Thousand Infallible Art of the Prince of Huainan) recorded that taking ***cengqing*** as medicine will bring the people longevity. ("淮南万毕术》载, "曾青为药, 令人不老。") [14]	Put ***cengqing*** and □ into the deceased to dispel the evils from all directions. ("以曾青、□木之精置中人, 除四方土害, 气消也") [15]
Baopuzi-Jindan (Gold and Cinnabar [pill of immortality]) records: trees and grass would be burned into ashes, while ***dansha*** be burned into mercury, then it will change into ***dansha*** again after an accumulation of time, so the common trees and grasses cannot compete with ***dansha***'s. ***Dansha*** can keep people longevity. (《抱扑子·金丹》): "凡草木烧之即煨,而丹砂烧之成水银, 积变又还成丹砂, 其去凡草木亦远矣, 故能令人长生。") [2]	/
Shuowen records that ***yushi***, a toxic stone. (说文曰邹礬石, 青石也。") [16]	/
Lunheng records, amber can absorb paper pieces, and ***cishi*** attracts the needles ("论衡》, "顿牟掇芥, 慈石引针。") [17]	The □Lord of *xuanwu* masters the pool of ***cishi***. ("□神玄武, 其物主者慈石池") [18]
Shengnongbencaojing mentions that ***xionghuang*** tastes bitter and plain. . .. It is capable of killing the ghosts, evils, malign forces and the hundreds of poison insects. . .. ("神农本草经": "雄黄味苦平. . ., 杀精物, 恶鬼, 邪气, 百虫毒. . .") [19]	Being buried with ***xionghuang*** in tomb will dispel the disease from five phases during four seasons and keep the ultimate wealthy. ("填(镇)冢雄黄, 四时五行可除咎去央, 富贵毋极") [20]

□: the inscriptions cannot be identified; /: neither single ***dansha*** nor single ***yushi*** inscription has been collected yet.

Table 2
Wushi in Chinese character, pinyin, suggested minerals and specific orientations based on historical literatures and archaeological inscriptions.

Chinese characters	Pinyin	Literal translation in English	Suggested minerals	Specific orientation
曾青	*Cengqing*	A stratified variety of blue substance	Azurite	East
丹砂	*Dansha*	Red stone-like substance	Cinnabar	South
(白)礬石	*(Bai)yushi*	(White) stone	Arsenopyrite	West
慈(磁)石	*Cishi*	Magnetic stone	Magnetite	North
雄黄	*Xionghuang*	Male yellow substance	Realgar	Center

archaeological inscriptions, are *cengqing* (曾青), *dansha* (丹砂), *yushi* (礬石), *cishi* (磁/慈石) and *xionghuang* (雄黄), but the accuracy of the documentation and objective judgment is worth verifying. This paper will focus on the research of groups of *wushi* found in three separate tombs, dated to the Eastern Han dynasty (AD 25–220), in *Xianyang*, Shaanxi province, and attempts to investigate the characterization of *wushi* by various spectroscopic techniques, then discusses the degree of uncertainty to identify *wushi* only by referencing the inscriptions without scientific analysis. Finally, the paper tries to explore *wushi* by observing their orientations in the tombs and aims to present an objective interpretation on *wushi* during the Daoist burial practices.

2. Materials

2.1. Wushi *minerals from three archaeological sites*

Three groups of *wushi* were accidentally uncovered in archaeological tombs with Daoist symbols during the construction project in Xianyang city, located ca. 30 km west from Xi'an, Shaanxi province, China, by Xianyang Archaeological Institute during 1990s (Fig. 1). These tombs are all dated to the Eastern Han dynasty (AD 25–220). First group of four minerals were found in separated pottery vessels from the site of Steel Tube Factory (abbreviated as STF). They are in red, blue, white and black (Fig. 2). Subsequently, another pottery jar accurately dated at AD 157 by red inscriptions on the surface, was excavated from campus site of Xianyang Normal Institute (abbreviated as XNI) in 1999, which yields a 1.5 cm long yellow block and several blue grains (Fig. 3). In the next year, a pottery basin full of sand containing five pottery jars distributed at four directions and the center was found in another earthen tomb unearthed in Xianyang International Airport Parking Apron (abbreviated as APA). A small pottery plate holding a kind of mineral is placed on the top of each jar, just like a lid (Fig. 4a). Four materials in violet, red, white and transparent color are respectively placed on the eastern, southern, western and northern plates, with a piece of yellow orange one in the center (Fig. 4b).

2.2. Experimental methods

The eleven minerals kept in pottery jars and plates unearthed from the sites of STF, XNI and APA are numbered from STF:01 to STF:04, XNI:01 and XNI:02, as well as from APA:01 to APA:05. Three analytical techniques were used: Raman spectroscopy, X-ray diffraction, and X-ray florescence to perform a series of measurements as summarized in Table 3.

Raman spectra were obtained with a Renishaw confocal micro-Raman 2000 spectrometer, equipped with a Leica microscope using a 50 × objective lens. The light source was an argon ion laser operating at an excitation wavelength of 514.5 nm. The laser power used was 5 mW. Accumulation time per spectrum was 10 s. All samples were placed on glass microscope slides and