



Study on the property of the production for Fengdongyan kiln in Early Ming dynasty by INAA and EDXRF



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ABSTRACT

A lot of official wares carved “Guan” or the dragon patterns were excavated on the strata of Ming dynasty of the Fengdongyan kiln site at Dayao County. The imperial porcelain was fired in Hongwu and Yongle eras. However, the emergence of this imperial porcelain has triggered academic debate about the property of Fengdongyan kiln in the Early Ming dynasty. Based on the differences of the official kiln management, some scholars have determined that the property of the production for this kiln was the civilian kiln. According to the historical textural records and typology, others preliminary confirmed that Fengdongyan kiln was the official kiln. In this paper, the elemental compositions of body and glaze in imperial and civilian porcelain are study by INAA and EDXRF for determining the property of the production for this kiln in Early Ming dynasty. After the processing of experimental data by geochemical analysis and principal component analysis, the result show that the raw materials for making body and glaze in imperial porcelain are similar with those of the civilian porcelain and the degrees of elutriation for body can be slightly different in HW-M period of Ming dynasty. The analytical results support the view that the Fengdongyan kiln is civilian not official.

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1. Introduction

Fengdongyan kiln, an important ancient kiln of Longquan, located in the valley 1.5 km from the north of Dayao County, in Longquan city (see Fig. 1). From September 2006 to January 2007, the Fengdongyan kiln was excavated by the Zhejiang Province Institute of Cultural Relics and Archaeology, the School of Archaeology and Museology in Peking University and the Longquan Museum. An area of over 1600 square metres was explored and a mass of exquisite Longquan celadon shards in Yuan and Ming dynasty were unearthed. In particular, abundant civilian porcelain and a lot of official wares carved “Guan” or the dragon patterns in the Hongwu (1368–1398 AD) and Yongle (1403–1424 AD) eras of the Ming dynasty were excavated on the strata of Ming dynasty [1].

In archaeology, due to the lack of specimens, the question about the existence of an official kiln in Longquan has only been modestly investigated. However, the emergence of the imperial porcelain caused academic debate about the property of Fengdongyan kiln in the Early Ming dynasty. At present, there are two main

views about Fengdongyan kiln. Some believe that it is the civilian kiln, while others think that it is the imperial kiln. “Longquan Kiln archaeological excavations expert meetings and press conference” was held in Longquan on January 18–19, 2007 [2]. Combined with the definition of official kiln, most experts believed that Fengdongyan kiln should belong to the civilian kiln, and the property of the production for this kiln was following government orders and producing the imperial porcelain. But according to ancient literature of the imperial porcelain [3], a large number of imperial porcelain was fired in Longquan kiln from Hongwu to Tianshun periods of the Ming dynasty. In addition, Longquan kiln and Jingdezhen imperial kiln have always been mentioned together. So some scholars believe that Fengdongyan kiln is similar to the official kiln of Jingdezhen.

Therefore, the identification of the Fengdongyan kiln is a problem that cannot be answered by only typological considerations. It is well known that the contents of major, minor and trace elements of the porcelain body and glaze depend on its raw material and manufacturing technology, which can be used to indicate the age of the porcelain and its provenance [4–6]. Different contents mean different recipes of body and glaze. In the ancient, due to strict hierarchy, the porcelain fired at the official kiln was used for the emperor. So the recipes and the dispersion degree of body or glaze

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Fig. 1. The overall view of Fengdongyan kiln.

in the official kiln were different from those of civilian kiln. The civilian and official productions of Ru Celadon have been researched focusing on their different techniques and glaze formulae [7]. The results mean that Ru official celadon and Ru folk porcelain were made from almost the same body materials but each has its own different glaze formula. So according to studying on the variation of raw materials and techniques between the civilian and imperial porcelain, the property of Fengdongyan kiln is discussed in our work.

In this paper, the chemical composition of the civilian and imperial Longquan celadon porcelain of Fengdongyan kiln were explored by use of Instrumental Neutron Activation Analysis (INAA) and Energy Dispersive X-ray Fluorescence (EDXRF). INAA is a promising method of elemental analysis. It has been broadly used in the archaeological field since E.V. Sayre's work [8]. The

EDXRF technique is a highly sensitive, non-destructive, multi-element analysis method with good repeatability [9]. The two techniques have been widely used to characterise the ingredients of ancient ceramics, glass, biomedicine and so on. From a statistical analysis of the elemental data, the raw material and the development of porcelain firing technology are discussed. The information is used to display the inheritance relationship of the raw materials used for the body and glaze in the civilian and imperial porcelain.

2. Samples and experimental

2.1. Samples

One hundred and sixty-four shards excavated at Fengdongyan kiln were selected as specimens. According to the typology, they

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