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Original article

The fractal structure of the Ming Great Wall Military Defense System: A revised horizon over the relationship between the Great Wall and the military defense settlements

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ABSTRACT

The Great Wall built during the Ming Dynasty (1368–1644) is the most representative World Heritage Site in China, featuring heart-stirring majestic momentum and rhythmical beauty. However, the Ming Great Wall did not comprise of only the linear defense wall as people have traditionally understood, but was rather a part of a much larger and a more complex system—the Ming Great Wall Military Defense System (M-GWMDS). Yet, this deep-rooted narrow understanding of this defense system has resulted in excessive attention on the Great Wall, which has as a result been the focus of the existing protection efforts, while neglecting the remaining parts of the M-GWMDS, most of which have been destroyed. This narrow focus stems primarily from the general lack of knowledge regarding the authenticity of the M-GWMDS. Therefore, in this work, fractal theory is employed in the analysis of the macro systematic relationships between the military defense settlement system and the Great Wall—the two core elements of the M-GWMDS. The obtained results show that the two elements were integrated into a complex collaborative system via fractal structure, enabling realization of specific systematic functions, such as efficient resource allocation, rapid army deployment, and highly effective cooperative defense. The operational mechanism of the M-GWMDS is further discussed from the perspective of systematic relationships.

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1. Introduction and research aim

1.1. The M-GWMDS

The aggressive and combative ancient Mongolian nomadic ethnic groups in Asia once posed a serious threat to other civilizations in Asia, while indirectly affecting the development of the ancient civilizations in Europe [1]. The nomadic civilization was geographically located to the north of Ancient China's agricultural civilization. Therefore, the China's most important political and military activities in this region were aimed at defending against the northern nomadic tribes. As a result, the Great Wall, which was expected to physically prevent or slow down rapid advancement of nomadic cavalry, was built and developed continuously [2].

The M-GWMDS was built during the Ming Dynasty (1368–1644) and was widely distributed along the northern borderland of ancient China. From Liaodong Tiger Hill in the east to Gansu

Jiayuguan in the west, the Great Wall stretched across approximately 8851.8 km, crossing nine provinces [3]. On its southern side, this system extended deeply into the country's interior, with the Great Wall marking its border. Because of the vast area the system covered, the geographic environment and enemy activities it had to withstand were complex. Thus, in order to improve the pertinence, nine military zones (also called nine towns) in the east–west direction were established, namely Liaodong, Jizhou, Xuanfu, Datong, Shanxi, YanSui, Ningxia, Guyuan, and Gansu [4]. On a larger scale, based on the specific geographic context and defense requirements, the nine towns were further integrated into the East District, the Central District, and the West District, allowing for unified management and strengthening the integrity of the defense in local areas. Xuanfu, Datong, and Shanxi in the Central District (Fig. 1) were adjacent to the capital and were the strategic core of the M-GWMDS [5]. The historical documents pertaining to these three towns are more comprehensive than those related to the East and West District, enabling further in-depth exploration. Therefore, the three towns were chosen as study materials for the present investigation.

The physical entity of the M-GWMDS was mainly composed of two core elements, the Great Wall and the military defense

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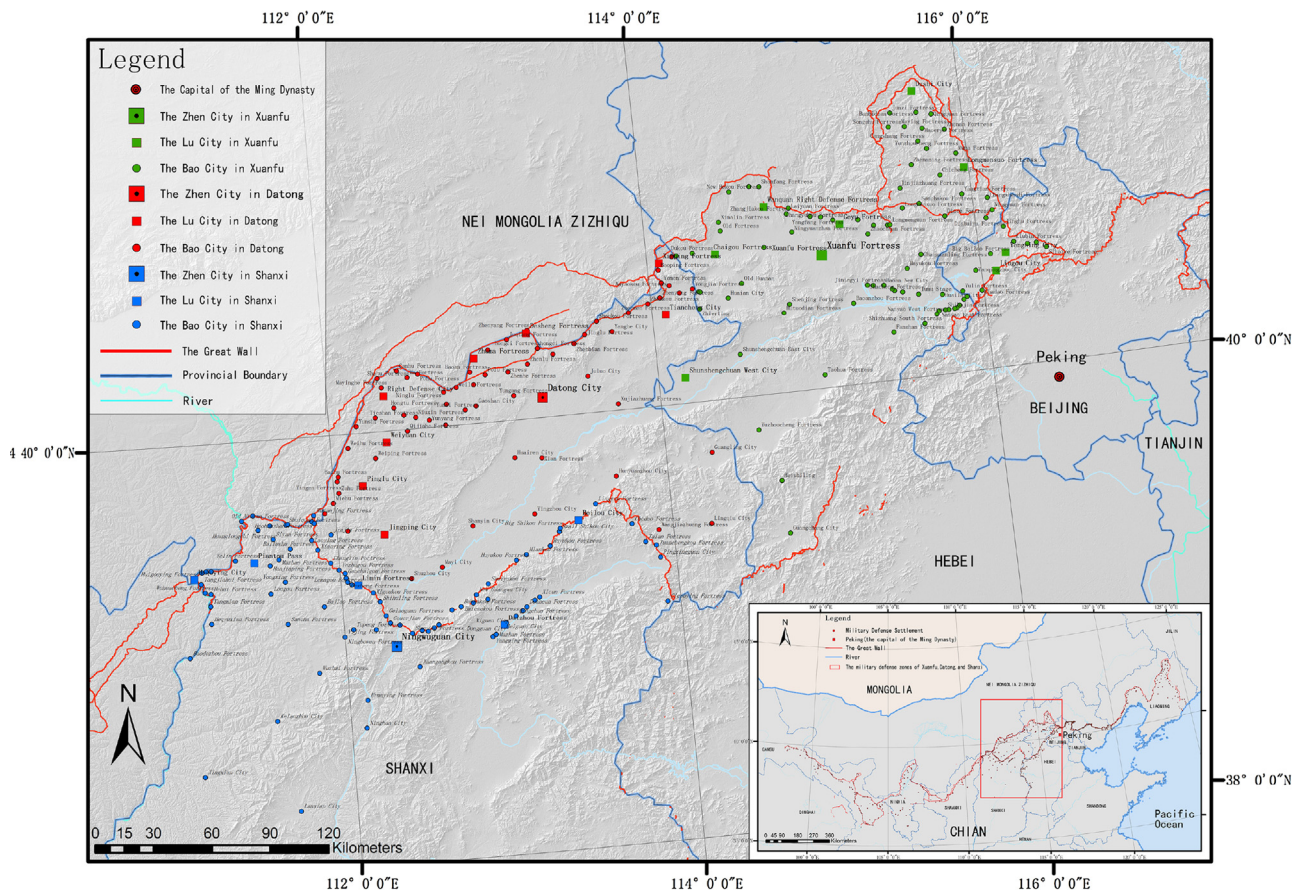


Fig. 1. The M-GWMS distribution in Xuanfu, Datong, and Shanxi towns.



Fig. 2. The Great Wall and the military defense settlement.

settlement system (MDSS; Fig. 2). While these two elements extended over a vast area, they nonetheless formed a complex system comprising of elements closely related through exchange of information, goods, and people based on military management relations, forming overall unified and well-coordinated defense system. The M-GWMS used a dual management system, the Zongbing system, and the DuSi Wei Suo system. Both systems had multiple levels, with each level in the Zongbing system controlling the corresponding level in the DuSi Wei Suo system. The former was responsible for military defense and important civil affairs, while the goal of the latter was mainly confined to the management of common civil affairs and agricultural production. Both systems performed their duties and provided complementary support to each other. This model was a special defense-oriented “military control” system in the border area [6]. From a macro perspective, the

M-GWMS management structure was delineated into four classes, comprising of Zhen city at the highest level, through Lu city level (including Lu city, Wei city, Suo city, etc.) and Bao city level, to the Defense Tower (Beacon Tower level) as the lowest level [7]. Using Datong Town as an example, its management relations could be described as a tree-like network (Fig. 3), whereby the representative settlements of the four classes were compared in terms of scale (Fig. 4). In general, the size of settlements and garrisons within the settlements was based on the class of the management structure, and reduced in size as the class degraded. Most importantly, the lower the level, the closer the settlement was to the Great Wall. Some of the defense towers at the lowest class were located in the Great Wall itself (Fig. 5), while others were distributed within the area it enclosed.

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