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Case Study of Field Mapping For the Woongsang Fault Overlap Zone in the Northern Dongrae Fault Zone, Korea

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Abstract : *In the southeastern part of the Korean peninsula is composed of Cretaceous sedimentary rocks and late Cretaceous to early Paleogene granitoids. There are fault zones with nearly vertical north-northeast trends that displace these rocks. Surface geometry of Dongrae faults and Woongsang faults show overlapping zone and show mutual crosscutting relationship as revealed by field mapping. The Dongrae Fault and the Woongsang Fault seem to be distributed almost parallel to each other on the surface of the ground, but they cross each other in the Woongcheon area in the northeastern part of the study area. In the Woongcheon area, the Dongrae Fault and the Woonsang Fault overlap each other and represent a complex fault development pattern. This pattern is considered to be related to at least four fault movements of the Woongsang Fault. The Dongrae Fault is not bent in the Woongcheon region, but rather overlaps with the Woongsang Fault, resulting in numerous secondary and tertiary faults, were exposed outcrops.*

Keywords *- Fault Zones, Overlap Zone, Field Mapping, Woongsang Fault, Korea Peninsula*

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I. Introduction

Major fault zones on the Korean peninsula are composed of Imjingang Belt, Okcheon Belt and Yangsan Fault Zone. Yangsan Fault Zone is composed of Jain Fault, Miryang Fault, Moryang Fault, Yangsan Fault, Dongrae Fault [1], Ilgwang Fault, and Ulsan Fault in south-east Korea (Fig. 1).

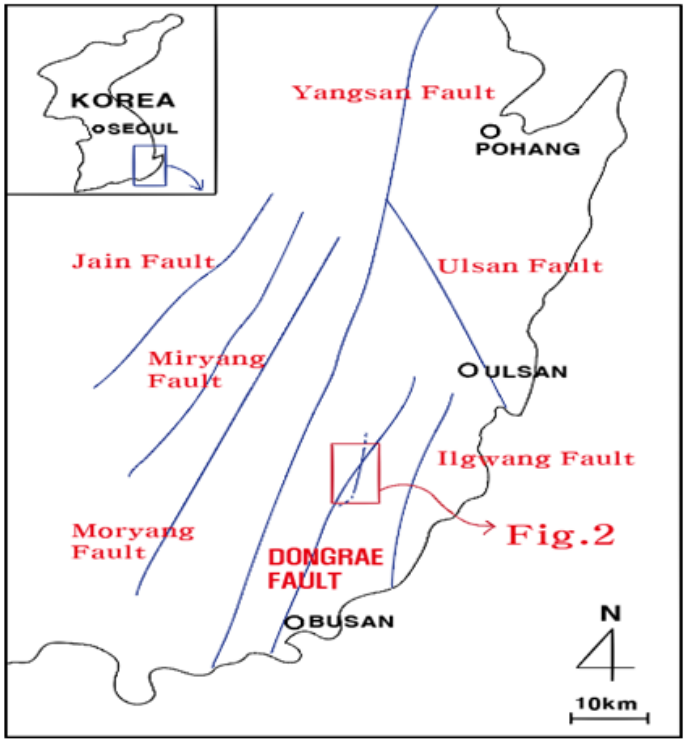

Fig. 1. Map showing the location of the study area and major faults in south-east Korea

Main fault zones on south-east Korea are systematic fault zones in which fault reactivation is believed to occur along late Paleocene to early Pleistocene faults [2] related to the opening of the East Sea (Japan Sea) [3]. In the study area, it is reported that only the Dongrae Fault is distributed along the Alluvial River and the Hoeya River along the Northeast and the Tertiary strata. Woongsang Fault is developed parallel to the Dongrae Fault [4-5], and the two faults overlap each other in the Woongcheon area.

This aspect of the Dongrae fault does not bent in the Woongcheon area, but exposes the complex fault structures in the outcrops, overlapping [6] with the newly discovered Woongsang Fault.

In particular, the Dongrae Fault Zone, which consists of the Dongrae fault and the Woongsang fault, is almost vertical attitude and NNE-SSW trending (Fig. 2).

II. Surface Geology

The surface geology of the study area consists of Daeyangdong Formation, Yangsan Formation, and Wonhyosan Formation going to the upper strata.

The lowest Cretaceous sedimentary rocks, the Daeyangdong Formation is composed of dark green sandstone, red shale and pale green siltstone, It is predominantly sandstone dominated and some cross-beddings are developed. Mean attitude of bedding of the Daeyangdong Formation is N70E~EW/10~20SE or N70W~EW/15~25SW.

The upper Cretaceous sedimentary rocks, the Yangsan Formation is composed of dark gray to black hornfels, dark gray sandstone and dark green silicified tuff, It is predominantly black hornfels dominated and some plagioclase bearing tuff are developed. Mean attitude of bedding of the Yangsan Formation is N70E~EW/10~40SE or N70W~EW/20~50SW and was disturbed by the granite intruded later.

The most upper Cretaceous sedimentary rocks, the Wonhyosan Formation is composed of dark gray to black andesite, dark greenish gray andesitic tuff, It is predominantly some plagioclase bearing lapilli tuff dominated. Mean attitude of bedding of the Wonhyosan Formation is N40E~EW/35~60SE or N50W~EW/30~50SW and was disturbed by the granites intruded later (Fig. 2).

The granitic rocks intruding to the Cretaceous sedimentary rocks in the study area can be divided into granodiorite, hornblende granite and pink-feldspar granite porphyry [7].

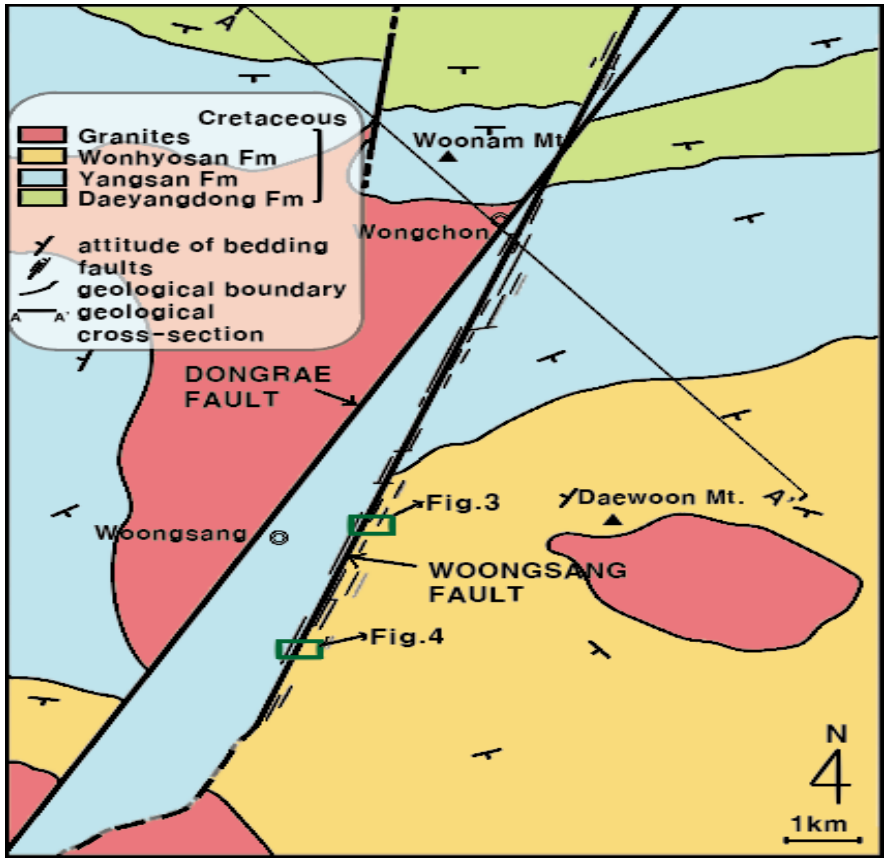

Fig. 2. Surface geometry of faults as revealed by field mapping in the study area

III. Fault Characteristics

The Dongrae Fault zone is internally zoned and occurs in the multiple fault cores. The major activities of the Dongrae Fault can be divided into two periods based upon K-Ar age data of the fault gouges: 51.4-57.5Ma and 40.3-43.6Ma [8].

The outcrops of the Dongrae Fault reported to exhibit at least two displacements are almost unobservable due to the expansion and construction of many roads and buildings. According to previous researches and reports, the Dongrae Fault has shown many movements, most of which are characterized by strike-slip movement of faults, especially dextral sense.

But, as a result of the precise field mapping, it was revealed that there are a few hundred meters wide new 'Woongsang Faults' almost parallel to the trend of Dongrae Fault over Woongsang-eup and Woongchon-myeon(Fig. 2).

Mean attitude of Dongrae Fault is N30E/70~89SE or N30E/70~89NW and Woongsang Fault is N20~25E/70~89SE or N20~25E/70~89NW, and it was revealed that there are 20 kilometers persistent.

As shown in Figure 3 and Figure 4, at least four faulting movements can be perceived by field mapping. According to the fault planes, striations, and crosscutting relationship, main fault plane(N15E 60SE) of Woongsang Fault and associated fault planes and striations measured at two outcrops representing the Woongsang Faults, at least four fault movements are suggested: L1, the first fault striation, is a 45 N60E(oblique-slip fault), L2, the second fault striation, is a 20 S(sinistral reverse strike-slip fault), L3, the third fault striation, is a 60 S30E(normal sinistral strike-slip fault), and the fourth fault plane and striation(L4) are N40E 60NW and 60 N80W(reverse dextral strike-slip fault).

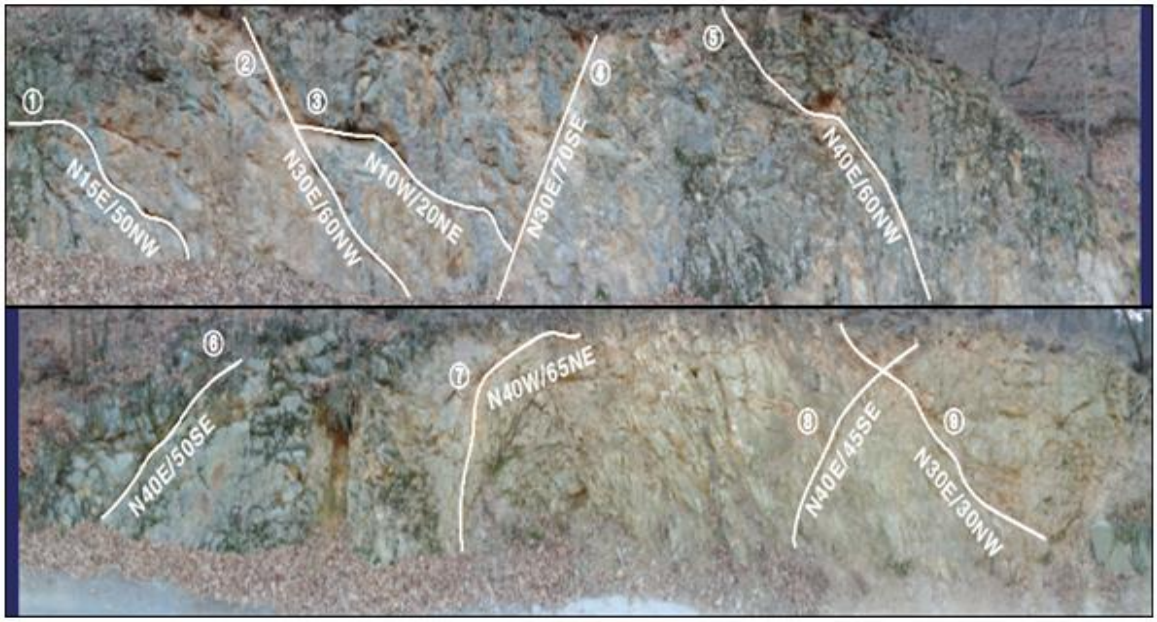

Fig. 3. Fault cores and associated faults of Woongsang Fault around the Woongcheon-myeon area

Fracture densities were measured at 11 sites along the fault trace at 200 m intervals in order to deduce the fault cores of the Woongsang Fault. The result showed 2.53 ~ 3.56 (1 / m). The fracture density in the 200m width and 2km long sections along the direction of the Woongsang Fault around Woongsang-eup tended to increase to the south of the study area. This is consistent with the fact that the displacement of the Woongsang Fault and the intensity of the faulting become weaker toward the north and disappear from the trace of the fault on the surface (Fig. 1).

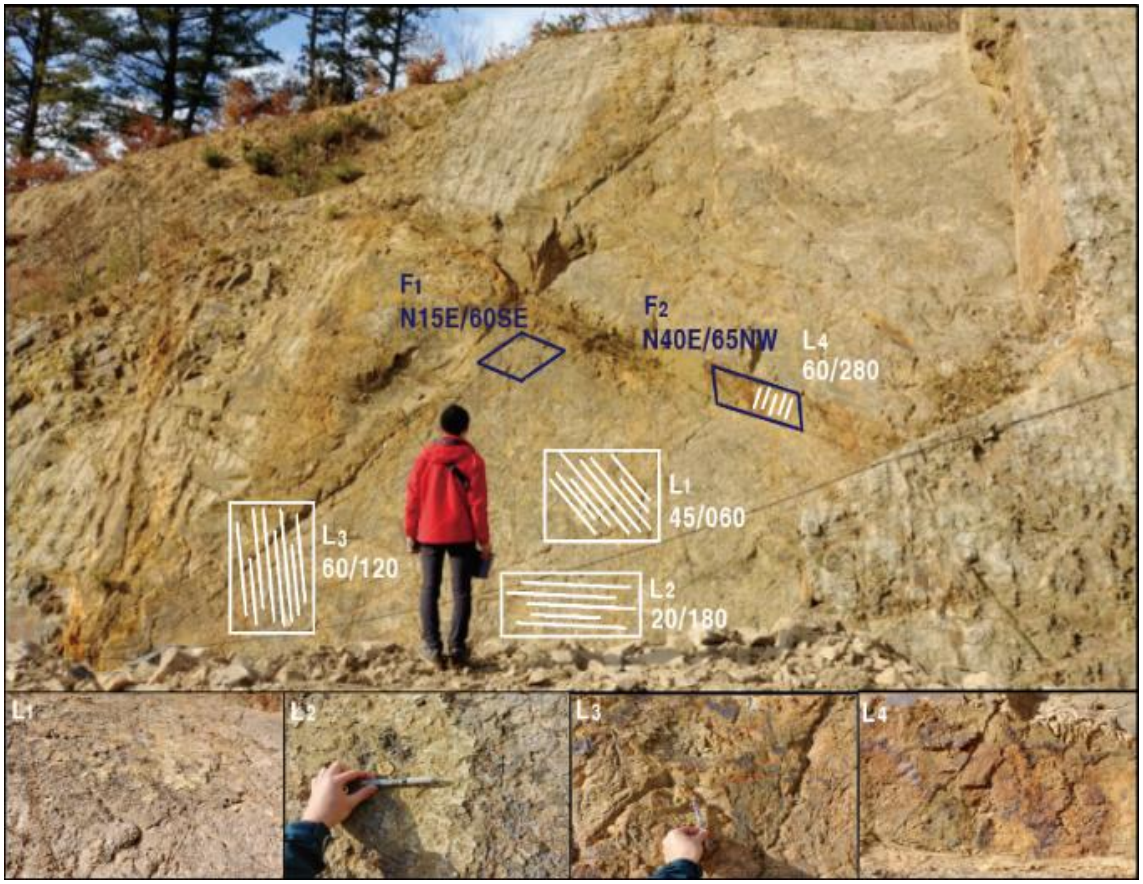

Fig. 4. Main fault planes of Woongsang Fault and associated fault planes cutting it, and fault striations around the Woongsang-eup area

On the surface, the Woongsang Fault and the Dongrae Fault develop parallel to each other or partially cross each other. However, the field mapping shows that the two faults have at least four fault movements, connecting the faults of various shapes and directions to each other or breaking each other (Fig. 5). In addition, for the geometry visible to the naked eye on these indicators, additional reliability can be increased if the internal geometry is verified and verified by analyzing the collected data using 3D exploration [9-11].

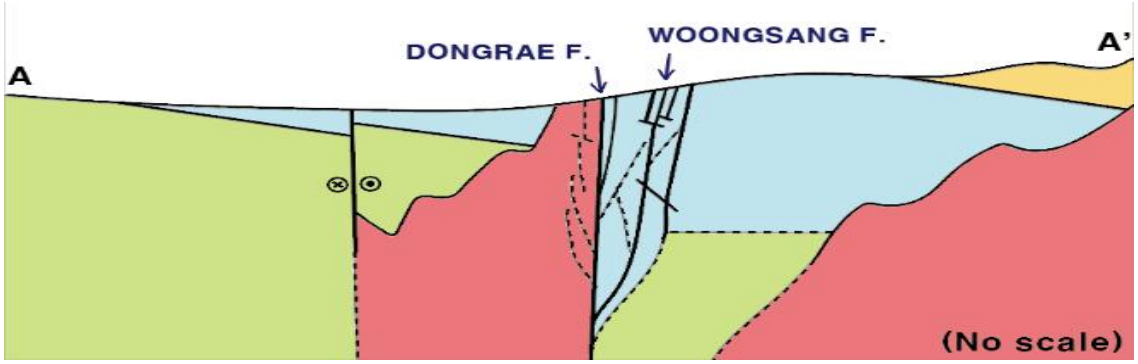

Fig. 5. Cross-sectional geometry of faults overlap zone along A-A' line in Figure 2

IV. Conclusion

The surface geometry of vertical faults overlap zone as revealed by field mapping: an example from the northern dongrae fault zone in korea was studied and major conclusions are as follows:

1. In the study area, Woongsang Fault is developed parallel to the Dongrae Fault, and the two faults overlap each other in the Woongcheon area. This aspect of the Dongrae fault does not bent, overlapping with the newly discovered Woongsang Fault.

2. The surface geology of the study area consists of Daeyangdong Formation, Yangsan Formation, and Wonhyosan Formation going to the upper strata.
3. As a result of the precise field mapping, it was revealed that there are a few hundred meters wide new 'Woongsang Faults' almost parallel to the trend of Dongrae Fault.
4. According to the fault planes, striations, and crosscutting relationship at two outcrops representing the Woongsang Faults, at least four faulting movements can be perceived by field mapping.
5. The displacement of the Woongsang Fault and the intensity of the faulting become weaker toward the north and disappear from the trace of the fault on the surface.
6. The field mapping shows that the Donrae Fault and the Woongsang Fault have a connecting the faults of various shapes and directions to each other or breaking each other.
7. In addition, it can be applied to the risk assessment of the ground during excavation work through the identification of the fault information and fault characteristics.

Acknowledgements

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