ON THE INTERRELATIONSHIP BETWEEN ENVIRONMENTAL CHANGES AND THE BEGINNING OF AGRICULTURE IN NEOLITHIC AGE IN THE MID-WESTERN KOREA

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Reconstruction of palaeo-environments is an essential necessity for archaelogists in pursuing their study. Prehistoric people were more controlled by the environments than we are now. At the same time they depended entirely on the environments to secure foodstuffs. Therefore, for the pursuit of palaeo-economy, most archaeologists firstly try to restore palaeo-environments in the geographical area of their study to the possible extent. As such, we have also reconstructed the natural environments of the Neolithic Age in Mid-Western Korea as much as we could, since this article is intended to relate environmental changes with the beginning of agriculture in the Neolithic Age.

1. The environments of Mid-Western Korea during the Neolithic Age

Korean Neolithic began at an interval between Pleistocene and Holocene. The interval took place ca. 10000 BP in Korea same as in the most parts of the world. From that time, environmental changes proceeded in Korea in the very similar way to those in Europe. The European divisions made by the use of pollen analysis, such as Preboreal, Boreal, Atlantic, Subboreal, Subatlantic, may apply to the changes in Korea as well. The climate was cool in Mid-Western Korea during the lower Holocene, as was during Preboreal and Boreal. It became warmer and warmer till Postglacial hypsithermal occurred ca. 6000 BP, just as did it in Atlantic. It then changed to be cool and dry again.

I would now like to focus on the environmental changes of Holocene in Mid-Western Korea in detail on the basis of the recent results of pollen analysis, diatom analysis, and sea-level change graphs that are put together hereunder.

1) Pollen Analysis

According to the results of pollen analysis in Mid-Western Korea, coniferous trees of Subarctic zones and deciduous broad-leaved trees of mountain climate zones gradually disappeared during the time frame of 10000 to 8000 BP. From 8000 BP the cool and dry climate was switched over to mild and humid conditions, and vegetation rapidly increased by Quercus.

Ilsan area, an alluvial plain on the valley located at the right side of Han-River near the Yellow Sea, has shown diagrams of the changing process of Oak tree (*Quercus*) – Alder (*Alnus*) – Pine (*Pinus*) during the period from 8000 to 6000 BP, which was comparable to

contemporaneous Mid-Eastern Korea where *Alnus* couldn't remain dominant. From 6000 BP AP (Arboreal Pollen) including *Alnus* and *Fraxinus*, and other hydrophilic species dominated with very rare appearance of NAP (Non Aboreal Pollen).

From 3000 BP there was a sharp decrease in temperate trees, whereas there appeared sudden dominance of coniferous trees, especially *Pinus*, followed by spore and NAP. NAP has been known as a main indicator of the short-time changes after introduction of agriculture. Such NPA as Mugwort (*Artemisia*), Chenopodiceae, and Umbelliferae came especially under those circumstances. Therefore, it is easily imagined from the appearance of *Artemisia*, Chenopodiceae, Umbelliferate with Gramineae that the agriculture in Ilsan area began during this period.

2) Diatom Analysis

Diatoms are divided into three kinds, i.e. that of fresh water, saltwater and brackish water, each representing from land, sea and tidal flat respectively. If saltwater diatoms are identified from an inland soil sample, it is presumed that the location from which the sample was taken was once sea. In this way diatoms are very useful in determining the original circumstances of a location.

Besides, diatoms are also helpful to estimate the fluctuations of sea level. With the use of diatoms we could infer even the micro fluctuations of sea level in Mid-Western Korea during 6000 – 5000 BP when the sea level was as nearly high as that of present time. Shown below are two graphs indicating fluctuations of sea-level in an alluvial plain approximately 6m above sea-level near Ilsan area (fig. #); and in a floodplain approximately 6m above sea-level along Dodaechon in Pyongtack (fig. #). Diatom samples were taken from three boring cores in those areas respectively.

3) Sea level changes

During the Late Glacial (LGM) in Korea, the Yellow Sea was exposed to be a land connected with China, and many rivers developed running through South Coast of Korea. In Holocene the sea level of Yellow Sea rapidly rose mainly due to postglacial hypsithermal.

Sea-level fluctuations of Holocene can be pictured through the combination of pollen-diatom analysis, existence of peat formations, and so forth. Many kinds of fluctuation graphs are now available, from which we can see that the level of Yellow Sea was rapidly rising until before and after 4000 BP when the mean sea-level went as high as 4 to 5m above the present sea-level (that is Flandrian transgression).

In sum, since 10000 BP, the climate in Korean Peninsula had become warmer resulting in rapid rising of sea-level, and *Quercus- Alnus- Fraxinus* had dominated by the virtue of humid and mild climates.

Faunas of subtropical zones had appeared in Korean Neolithic as well. For example, there were buffalo (*Bubalus bubalus*), coral, a subtropical/tropical kind of abalone (*Nordotis*

gigantea), a kind of roe deer (*Hydropotes inermis*) and etc., which are considered to be evidences of warm temperature.

Even after the climatic optimum the environments in Mid-Western Korea continued to be in humid conditions because the area was exposed for long under the influence of Flandrian transgression. Swamps and peats were formed in and around most tidal flats. Agriculture might have begun around these swamps and peats. From ca. 3000 BP sea-level regression took place in Yellow-Sea, enlarging peats vastly. Doing agriculture became widely prevalent, *Pinus* and NAP dominating at last.

2. Archeological data showing the beginning of Agriculture

Until now, the subsistence ecenomy in the Neolithic Age in Korea have been known to be gathering, hunting and fishing. Agriculture seemed to have been done on an extremely small scale after the middle age of Neolithic. However such views are being modified as recently many evidences were found from Neolithic sites. Charred grains excavated from dwelling sites or rice grains from peats, and rice phytoliths obtained through scientific analysis are as follows:

	Archaeological sites	Grains	Age
1.	Namkyong dwelling site #31, Pyung Yang	Foxtail millet	Late stage
2.	Gitapri dwelling site #2, Hwanghaebukdo	Foxtail millet or banyard millet	Early stage
3.	Masanri dwelling site #7, Hwanghaebukdo	Foxtail millet	Early stage
4.	Sungjuri peat, Ilsan	Rice grains	4070+-80 bp
5.	Daewhari silt, Ilsan	Rice grains	4330+-80 bp
6.	Jooyopri, Ilsan	Rice phytolith (plant opal)	4330-4770 bp
7.	Gahyonri peat, Gimpo	Rice grains, foxtail millet	4010+-25 bp
8.	Daechonri dwelling site, Choongchunbukdo	Rice grains, rice, wheat, barley, foxtail millet, soybean, hemp seed	4400+-60 bp
9.	Jodongri, Choongchungbukdo	Plant opal on pottery	Late stage
10.	Sangchonri dwelling site #5, Kyungsangnamdo	Foxtail millet or banyard millet	Middle stage
11.	Nongsori shell-midden, Kyungsangnamdo	Plant opal on pottery	Late stage
12.	Dongsamdong dwelling site #1, Busan	Foxtail millet, Chinese millet	4590+-100 bp

#1 - #7 from mid-western part of Korea

#8 - #9 from inland near mid-western part of Korea

#10 - #12 from southern part of Korea

Judging from these archaeological data, Neolithic people of Korea might have performed G/H/F in the early stage of the period and have practiced agriculture (domestication and cultivation as it were) widely from the middle stage, ca. 4500 – 4000 BP of the period. They bred many kinds of millet, wheat, and barley as well as rice. When agriculture had begun is fairly presumed to have coincided with the time peats were enlarged.