

Archipelago Tidal Flats in Korea: Sedimentological and Geoheritage Significance

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Abstract

Island-type tidal flats along the western coast of the Korean Peninsula have been developed due to rapid sea-level rise on broad marginal sea (Yellow Sea) since the demise of the Last Glacial Maximum. The tidal flats are characterized by large elongate subtidal sand bars and broad intertidal and supratidal mud flats with spring tidal range reaching up to 7.8 meters. Geomorphic features, surface sediments and core data show that intertidal flats can be divided into upper intertidal zone and lower intertidal zone. Upper intertidal zone dips gently seaward with tidal creeks, which changes from mud- to mixed-flat sedimentary facies with seaward coarsening in average grain size. Dominant sedimentary facies are homogeneous mud (highly bioturbated) and thinly interlaminated sand/mud to coarsely interlaminated sand/mud (wavy and lenticular bedding) showing seasonal stratifications. Surface topography of lower intertidal flat is characterized as sand-bar complex migrated landward. The bars are reaching up to 1.5m in height, and shore-parallel tidal creeks are developed between individual bars. Dominant sedimentary facies is sand-flat facies except for the mixed-flat facies occurring near boundary of two zones. Broad tidal flats around the islands of the Shinan and Seocheon areas associated with macrotidal range in very shallow epicontinental sea (Yellow Sea) display outstanding geological processes and geoheritage significance, which can be a strong potential for the nomination of natural World Heritage site.

Introduction

- World Heritage is the legacy from the past, what we live with today, and what we pass on to future generations. Our natural heritage is irreplaceable sources of life and inspiration.
- Special island-type tidal flats are mainly distributed in the southwest part of the Korean Peninsula, especially Shinan and Seocheon counties. They consist of all kinds of tidal-flats like mud-flat, sand-flat, mixed flat, and even rocky-flat, which are differently distributed from area to area depending upon the location of islands and oceanographic conditions.
- The objectives of this project are to characterize the sedimentological and geoheritage significance of Korean island-type tidal flats and to show their outstanding universal values to be nominated as a serial natural World Heritage sites.

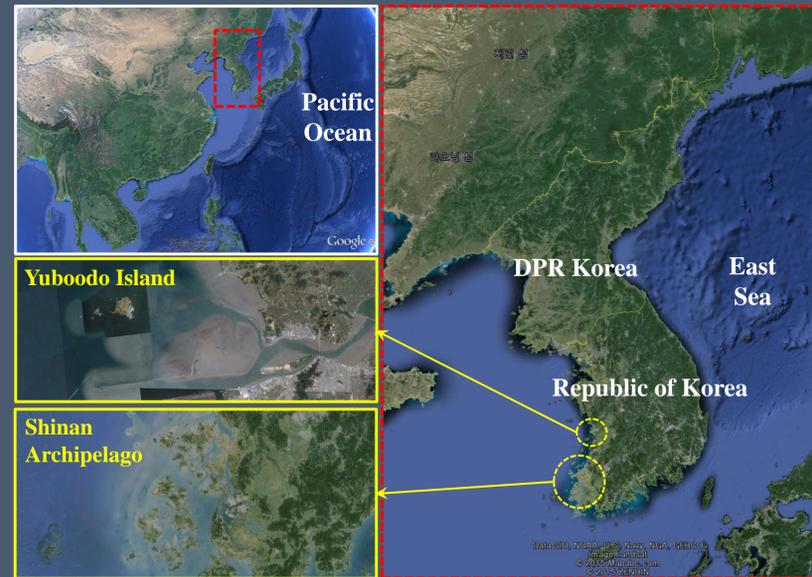
Geographic and Geologic Setting

- Shinan Archipelago and Yubodo Island are located in the southwest part of the Korean Peninsula.
- These serial nominated sites are composed of the Shinan Archipelago with 1004 islands and Yubodo Island.
- These islands were formed by rapid sea level rise on shallow broad continental shelf in Yellow Sea since the Last Glacial Maximum.
- Geology of the area: Shinan Archipelago is composed of Cretaceous sedimentary, volcanic and plutonic rocks and Yubodo Island is composed of Precambrian granite and gneiss.

Oceanographic Setting

- Yellow Sea is a part of the Asia continent where shallow sea was formed by flooding of seawater onto broad shallow continental shelf due to rapid sea-level rise since the Last Glacial Maximum.
- The seafloor has been submerged and inundated many times during the alternating glacial and interglacial periods of the Pleistocene.
- Bathymetry; maximum depth (140 m) / average depth (44 m)
- Average tidal range; Shinan Archipelago (301.0 cm) / Yubodo island (447.2 cm)
- Maximum tidal range; Shinan Archipelago (526 cm) / Yubodo island (781 cm)
- Temperature / Salinity ranges: 13 ~ 16°C / 31.5 ~ 32.7 psu

Location



Tidal flat Sediments and Depositional Processes

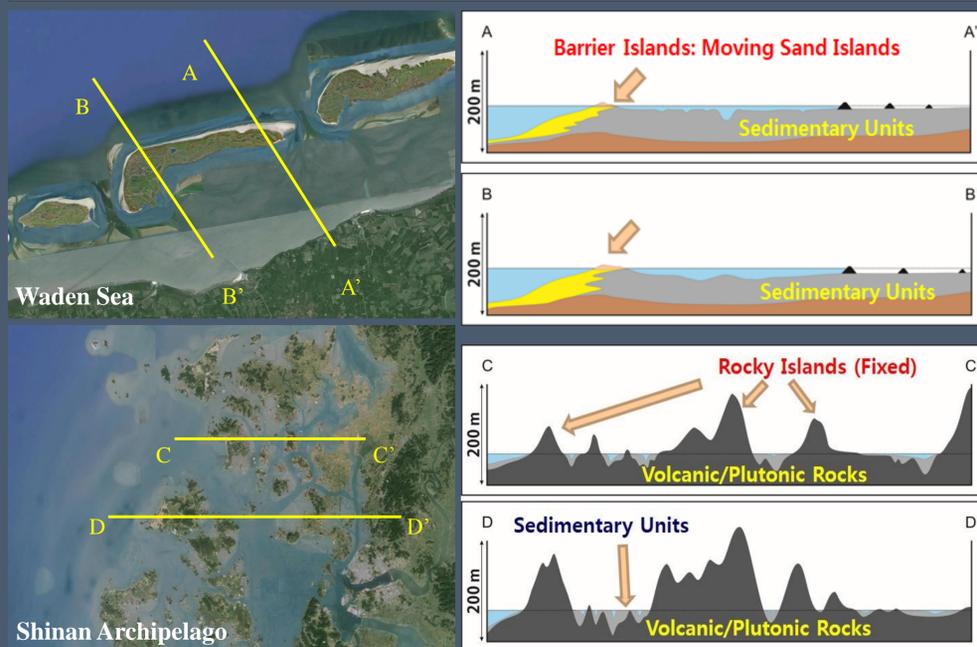
- Surface sediment facies are composed of sand facies, muddy sand facies, sandy mud facies, and mud facies. Gravel facies are shown but the distribution is restricted in some areas.
- Generally, outer part is represented by sand facies and inner part is by mud facies.
- Sedimentary structure: cross-laminated sand, parallel laminated sand, homogeneous mud
- Seasonality: island-type tidal flats shows the characteristic that more granule sediments are increased by waterways than the existed ones. This is because a sediment transportation is very active by increasing northwest wind in winter.
- Based on 3D Geomorphology: (below), detailed geologic seasonal changes can be observed.

Sedimentary structure

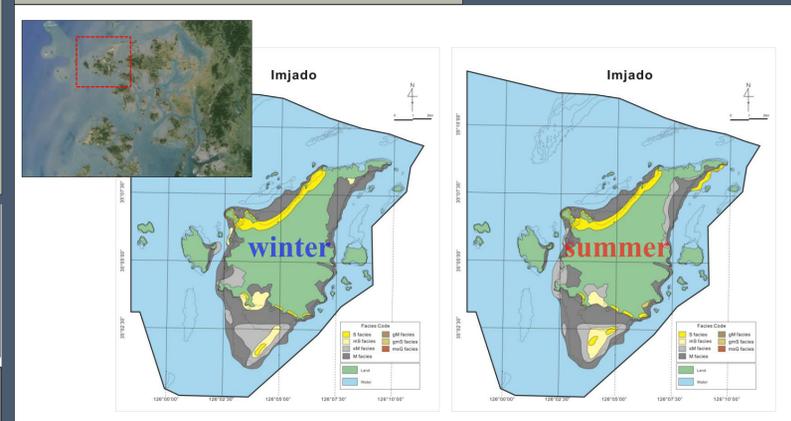


Comparison with the Other WH Site (Wadden Sea)

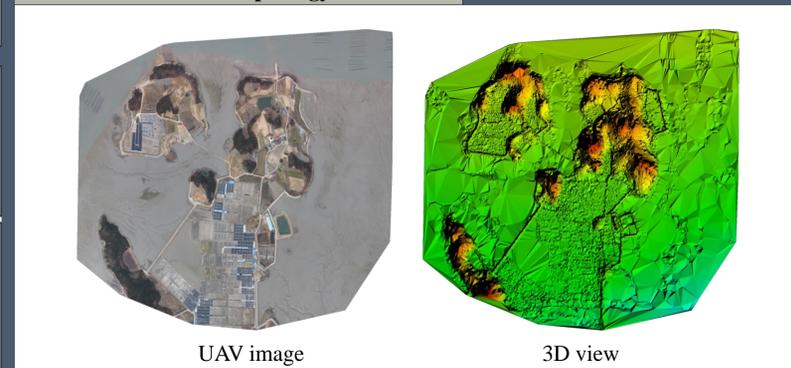
- The only inscribed tidal flat site in the world is the Wadden Sea tidal flat from Denmark to Netherlands.
- The Wadden Sea tidal flat is entirely different from Korean tidal flat because Korean tidal flats are surrounded by numerous islands and high mountains without any barrier islands whereas Wadden Sea tidal flat has barrier island paralleled to the shoreline towards the sea.
- Thus, Wadden Sea tidal flat was influenced by incoming waves and tidal currents whereas Korean tidal flats are mostly affected by tidal currents around the islands.



Surface sediment distribution



3D Geomorphology



Summary and Future Plan

- Compared with the Wadden Sea World Heritage (2009), Korean tidal flats have their own unique island-type tidal flats producing outstanding scenic views and a variety of tidal flat environments resulting from complicated endogenic controlling factors on a broad and shallow continental shelf. Therefore, the serial nominated sites of Korean tidal flats have a great potential to be inscribed as a natural World Heritage based on criteria (vii) and (viii).
- Based on further research on ecology and human use of the nominated sites, the Phase II plan will be carried out for the nomination as a mixed World Heritage site in the future for the criteria (iii), (v), (ix), and (x). Continuous biological monitoring will be necessary for this goal.

Criteria to Be Nominated

- Criteria (vii) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance:** Island-type tidal flats of Korea may be the only place to displaying exceptionally beautiful scenic views in the world because the tidal flats have formed in broad shallow sea (Yellow Sea) with numerous topographic highs. High areas became islands after the broad flat area was submerged due to rapid sea-level rise. Other tidal flats of the world mostly show a simple horizontal landscape.
- Criteria (viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features:** Island-type tidal flats of Korea may be the only place in the world showing the special sedimentation processes in a tidal flat environment between numerous islands on broad epicontinental shelf. Macrotidal currents combined with waves and typhoons in semi-closed oceanographic setting have provided unique geological and oceanographic conditions to produce massive tidal sediments. Various types of tidal flats (mud-, sand-, mixed and rocky tidal flats) could be produced because of the unique sedimentation processes between islands on a very shallow, broad and uniform continental shelf under the influence of macrotidal currents and frequent typhoons.

Shinan Archipelago



Yubodo Island

