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Sand dunes formation and development in Ili-River delta and Lake Balkhash area, Kazakhstan

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1. Research background

The Subjects of this study is about the relationship between environmental change and sand dune formations in Saryyesik Atyrau Desert, South-East Kazakhstan. Environmental change of the desert is closely related to those in Lake Balkhash and Ili River delta. The 'ILI-PROJECT' members have been studying environmental changes in Lake Balkhash and Ili River delta during Pleistocene to Holocene (Kubota,2010;Endo et al,2010a;Endo et al,2010b). Some researches, acoustic survey and boring in Lake Balkhash (Haraguchi et al, 2010), analysis of lake sediment (Sugai et al, 2010), diatom (Chiba et al, 2010), river terrace sediments and the ¹⁴C dating at Lepsy River (Sugai et al, 2010), analyses for meander wavelength of Ili River and the paleochannel (Shimizu et al, 2010), and ¹⁴C dating about the sediments (Shimizu et al, 2011) have been conducted. Dune formations and patterns show important factors about paleoclimate and paleoenvironment in arid area (e.g. Lancaster, 1995). In case of this study, research for sand dune patterns, stratigraphical relation of sand dunes and fluvial sediments, and age determination of those, are investigated. On the basis of the results we will discuss the lake level change, arid condition about paleo ili River delta, paleoenvironment and paleoclimate in central Asia.

2. Classify of Ili River delta and Sand dune pattern

In this study area, the annual precipitation is about 150mm. Ili River delta are classified into alluvial plain and some paleo-delta plain(T1: high terrace covered with sand dunes, T2 and T3: paleochannels running to north) (Shimizu et al, 2011). In T1 delta, main sand dune pattern are running NW-SE and also NE-SW direction (crossed pattern). These are composed of Draa(mega-linear dune: length:30km over, height:50m over, wavelength:1km over) are developed in the south desert. At the estuary of Aksu River, the southern coast of Lake Balkhash, there are NE-SW linear dunes partially submerged. Sand dunes in T2 paleo-delta covered paleochannel. Small vegetated Sand dunes in T3 paleo-delta before 13th C are developed (Shimizu et al, 2011).

3. Prevailing wind directions at present

Surface wind direction (influenced by the prevailing wind) is principal factors of the sand dunes pattern. The observatory data in wind direction indicate mainly NNE-NE(55%) and SW-SSW(12%) at Balkhash city (Northern coast of Lake Balkhash), NNE-NE-ENE(71%) at Bakanas(center of Ili River delta). In winter season, the temperature and wind direction shows strong cold air supplied from NE-NNE, and the origin of the wind is considered to be 'Siberian high'. We need more researches for understanding about the relationship between present wind direction and sand dunes pattern.

4. Paleoenvironment changes from sand dune studies

The Crossed Draa patterns covering T1 paleo-delta, suggests shift of paleo-wind directions after T1 paleo-delta. The OSL dating result, from the upper part of a linear dune partially submerged at the estuary of Aksu River, shows about AD 200 (Endo et al, 2010a), matching to the reduced phase of Lake Balkhash from studies of the lake sediments. In the lake shrinking phase, dry-up lake bottom might have provided aeolian sand to form the linear dunes. The small dunes in T3 paleo-delta, show that the condition in dune formation has continued after 13th C. But most of sand dunes are 'inactive' or 'vegetated' at present. It suggests that those inactive or vegetated dunes had been formed under the past conditions of higher aridity and stronger wind. The presentation will discuss using more climate data and analysis of geomorphology.

Reference..Chiba et al (2010):Abs.JAQR.40.16-17..Endo et al(2010a):Abs.JGUM. HQR010-12.. Endo et al (2010b):Ili Project, 93-104.. Haraguchi et al (2010):Abs.JGUM.HQR010-10.. Kubota et al(2010): Abs.JGUM.HQR010-09.. N.Lancaster (1995):228-254.. Shimizu et al(2010):Abs.JAQR.40.14-15..Shimizu et al(2011):Abs.AJG.100240.. Sugai et al (2010): Abs.JAQR.40.82-83..

Keywords: sand dunes, Draa, wind direction, Ili-River delta, Lake Balkhash