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Typology of Fan Delta Morphologies at Lake Baikal, Siberia

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The morphology and shape of river fans are a product of fluvial deposition and environmental conditions which are both subject to various controlling factors. Therefore, studies of fan delta morphologies not only aim at characterizing depositional environments but also at reconstructing the evolution of morphologies in order to describe past and present climate boundary conditions. By using remotely-sensed satellite imagery and digital elevation models, quantitative morphologic characteristics such as sizes of drainage basins, transport areas and areas of deposition can be derived from spatial analysis for large areas by semi-automatized procedures. In this work we conducted a comprehensive study of 33 fan deltas at Lake Baikal. Differentiation of individual typologies is based on previous work by [1] and [2]. Lake Baikal has been selected as study area because of its size, location and variable shore physiography and is considered well-suited for the study of the genesis of fan deltas and their controlling morphologic factors.

For mapping of individual fan delta bodies multispectral images of the Landsat Enhanced Thematic Mapper (ETM) were used. For the determination of morphometric parameters as input data for subsequent hydrological studies, photogrammetrically derived digital terrain model data of the ASTER instrument as well as direct measurements obtained through the Shuttle Radar Topography Mission (SRTM) were utilized.

Typical hydrodynamic factors are sizes of catchment areas, the morphometry of associated rivers and slope angles as well as sizes of fan deltas as summarized by [1] and [2] as so-called ‘influencing factors’. In contrast to earlier studies we separated different types of fans and analyzed them individually in order to relate shape and morphometry to environmental factors. Our analyses generally confirm that there is a positive correlation between e.g., fan areas and sizes of catchment areas as well as between fan areas and lengths of valley lines of associated rivers. Additionally, our analyses show a negative correlation between average fan slopes and sizes of catchment areas. The observations are in good agreement with previous dispersed analyses from other areas. The applied methodology proved to be adequate to be compared to field investigations as confirmed by our results. Additionally, a separation and analysis of different typologies provided much clearer distributions and better correlations between different fan morphologies which allows to constrain boundary conditions and their potential influence on shape in a much more efficient way.

[1] Blair & McPherson (1994) J. of Sed. Res., A64: 450-489; [2] Stanistreet & McCarthy (1993). Sediment. Geol., A85: 115-133.