Reconstruction of drainage evolution in a Large Igneous Province: Intra-basaltic sedimentation in the Columbia River Basalt Province, Washington State, USA

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1. Introduction

The Miocene Columbia River Basalt Province (CRBP) provides an excellent case study for drainage evolution, and the interplay between volcanism and the environment in Large Igneous Provinces (LIP's). The CRBP lava field comprises a number of extensive basaltic lava flows, which are intercalated with sedimentary interbeds of fluvial, lacustrine and associated palaeosol environments. Based on sedimentary facies analysis, the intra-basaltic drainage system development can be grouped into an early, middle and late stage evolution.

2. Drainage system development

The three main stages of drainage evolution are closely linked with the LIP evolution: 1) an early stage of CRBP evolution characterised by high volcanic effusion rates. At this stage fluvial systems dominate the marginal lava field. Lacustrine settings and palaeosols existed within the central part of the CRBP. 2) a middle stage of CRBP evolution of waning volcanic activity, during which the drainage is dominated by lacustrine environments. 3) a late stage of CRBP evolution, which is marked by very low effusion rates and significant ash fall out events. The drainage is characterised by well established river systems advancing towards the lava field centre.

3. Influence of volcanism on sedimentation

Based on the present studies the CRBP drainage evolution is strongly driven by the interplay of changing effusion rates and volumes, lava field topography, lava flow distribution and the location of the volcanic centres. Ash fall out and the formation of local basaltic spatter cones influenced interbed composition, and may also have been affected location and flow orientation through damming.

4. Conclusions

The undertaken studies on the interbed sedimentology and adjacent basalt flows revealed a complex interplay between sedimentation processes, the environment and volcanic activity. Additionally, sedimentation within the CRBP is further affected by external volcanism of the Cascade Range and the Yellowstone Hotspot. This study provides a model for the control of CRBP drainage evolution in particular and can be used to improve our understanding of sedimentary processes in continental LIP's in general.

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