*Joint Controlled Channeling in the Columbia River Basalt**

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ABSTRACT

IN THE COURSE of mapping the Haas Quadrangle, which includes much of the mouth of the Cheney-Palouse River scabland tract in southeastern Washington, a marked pattern of channeling was observed on the aerial photographs and studied in the field. This pattern is believed to result from control of the channel erosion by regional joints and, more specifically, by zones of close jointing and minor shearing within the major joint system.

INTRODUCTION

THE ORIGIN OF THE CHANNELS in the basalt scablands of southeastern Washington has been a subject of controversy for many years. One of the unanswered problems in this controversy is the presence of certain linear channels or coulees which have been cut into the rock floors of portions of these scabland areas. This paper gives evidence for the control of orientation and localization of some of these subsidiary channels but does not attempt to explain the mechanics of their erosion.

The channeled scablands consist of four major tracts along which glacial meltwaters flowed in a southwesterly direction. These meltwaters cut through a thick mantle of loess and exposed and eroded the underlying basalt. This denuded basalt is known locally as scabland or scabrock. The largest and easternmost of these tracts is the Cheney-Palouse River tract which trends southwest from the vicinity of Spokane. At the southern end of the Cheney-Palouse River tract the meltwaters drained through Washtucna Coulee and, in part, spilled across the drainage divide between Washtucna Coulee and the canyon of the Snake River. This outlet area is shown in Figure 1. The field

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studies on which this paper is based were largely confined to the Haas Quadrangle which is the western half of the area shown on Figure 1.

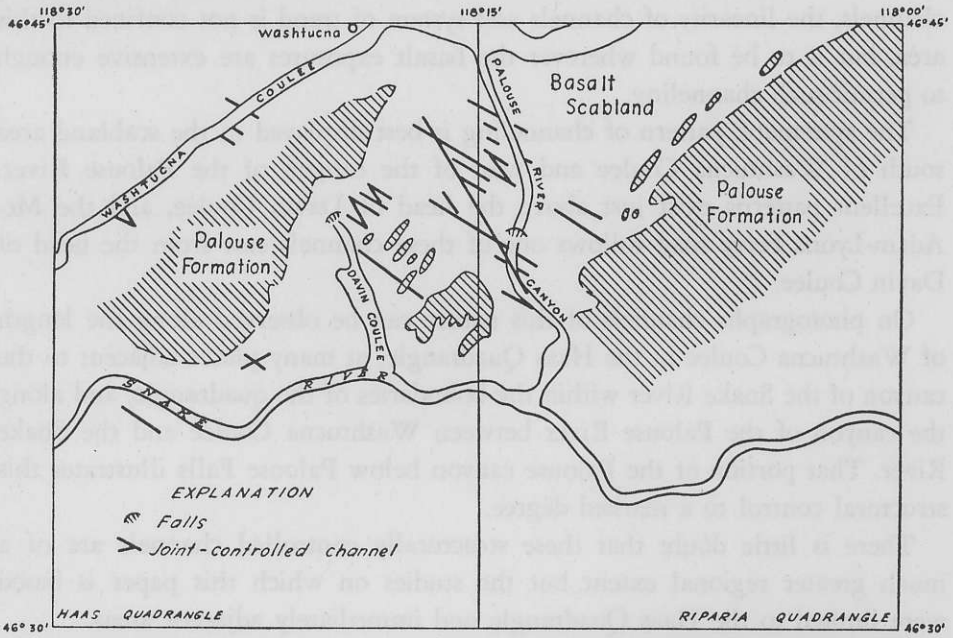

Fig. 1.—Generalized map of trend pattern of joint-controlled channels in basalt, Haas, and Riparia 15-minute quadrangles, Washington.

The spillway tract between Washtucna Coulee and the Snake River is 7–8 miles wide and is margined by steep scarps cut into the soft loessial silts which support the wheatland of the region. Some isolated islands of these silts lie within the tract, elongated with the trend of the tract. The Palouse River flows across this spillway tract and has its mouth near the east margin of the spillway outlet.

Many deep, narrow, linear channels have been incised into the basalt floor of the spillway tract; it is with these subsidiary channels that this paper is concerned. These channels may be described as long narrow slots, commonly closed at both ends, which never necessarily carried a stream along their length. Their trends are generally transverse to the trend of the drainage course in which they lie. Moreover, the trends of these channels form a marked system or pattern when observed on the aerial photographs or on a topographic map. These distribution patterns and certain field data have resulted in a thesis of control of erosion of these channels by a regional joint system in the basalts.

Location

ALTHOUGH THE SPILLWAY TRACT contains the best-developed pattern of channels, the linearity of channels and system of trend is not confined to this area, but is to be found wherever the basalt exposures are extensive enough to permit such channeling.

The systematic pattern of channeling is best displayed in the scabland area south of Washtucna Coulee and west of the canyon of the Palouse River. Excellent patterns exist just above the head of Davin Coulee, and the McAdam-Lyons Ferry road follows one of these channels east from the head of Davin Coulee.

On photographs channels of this nature can be observed along the length of Washtucna Coulee in the Haas Quadrangle, at many places adjacent to the canyon of the Snake River within the boundaries of the quadrangle, and along the canyon of the Palouse River between Washtucna Coulee and the Snake River. That portion of the Palouse canyon below Palouse Falls illustrates this structural control to a marked degree.

There is little doubt that these structurally controlled channels are of a much greater regional extent but the studies on which this paper is based were limited to the Haas Quadrangle and immediately adjacent areas.

Description of the Channels

TWO TRENDS of the joint-controlled channels are common although others are known. One set trending N. 30°–40° W. and an intersecting set with a N. 60°–70° W. trend are conspicuous and persistent. The trends of these channels are transverse to the trend of the scabland tract in which they lie.

The size of the joint-controlled channels ranges from small incipient channels to large coulees such as the one in sections 22 and 23, T. 14 N., R. 36 E. that contains Deep Lake. This coulee is more than 2 mi. long, nearly 1000 ft. wide, and more than 200 ft. deep.

Many of these channels are completely closed by basalt lips at each end, the total closure exceeding 100 ft. in the above-described coulee. No glacial deposits have been observed on the floors of these coulees but talus obscures the bedrock floor.

The walls of the channels are steep and commonly vertical. The linearity of the channels, which is conspicuous on photographs, is not obvious in the field because of the irregularity of the walls and the magnitude of the channels.

Evidence for Control by Jointing

Evidence for joint control of the described channeling is in part topographic and in part geologic. The topographic evidence may be listed: (1) linearity and persistence of channels, (2) system of trend pattern of channels, (3) position of channels transecting trend of scabland tract, (4) steepness of channel walls and lack of obvious differences in erosion of north and south walls.

This topographic evidence is obvious on both aerial photographs and on topographic maps. Even without supporting field evidence, a study of the topographic evidence on the photographs and maps inevitably results in the thesis of joint control of the channels.

Awareness of the topographic nature of the channels, however, led to a detailed field study of the channels. The rims of the major channels, rock lips, floors, and reentrants were examined for structural evidence which might explain these anomalous features. The floors of the channels are covered by talus, but small tight joints were seen on the rock lips at the ends of the closed channels. Similar joints were observed along the rims of the channels. These joints, regional throughout the area, transect the columns and are not cooling joints. Although tight and inconspicuous, they are present at many places throughout the area of exposed basalt, even where there has been no channeling by glacial waters.

However unsatisfactory these tight joints may seem as an explanation of the control of such channeling, they remained, until recently, the only evidence of structural control of the channel erosion. During a recent field check of the quadrangle, however, additional evidence was observed which offers more substantial support to the thesis of joint control of the channeling and probably indicates the cause of positioning of the channels.

Immediately south of the Palouse Falls viewpoint on the west side of the river is a steep, deeply incised, vertical-walled narrow ravine, down which a trail leads to the canyon floor. On the floor of this gut is a zone of close jointing and shearing, with probable minor displacement, about 1 ft. wide. The trend of the ravine can be extended across the canyon along similar ravines and notches to the east rim. This type of concentrated fracturing along major lines of adjustment probably has controlled the channeling.

Conclusions

Near the mouth of the Cheney-Palouse River scabland tract many well-defined channels transect the trend of the scabland tract. The topographic evidence of linearity of channels, system of pattern of channel trends, and position of channels transverse to direction of meltwater flow; and the geologic evidence of associated regional jointing, which, in places, contains zones of very close jointing and shear, indicate that the erosion of the channels was controlled by joint structures in the basalt. The region, structurally, is one of low, southwest-trending folds in the basalt. The regional joints are without doubt related to the folding but studies have not been extended to an analysis of the joints to indicate such relation.

Highway Problems in Basalt

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Good highway materials are increasingly more difficult to find and have resulted in an intensified search for gravel and quarriable material throughout the state. Of all quarries used for highway purposes, over 95 per cent are in basalt type rocks.

Hardness, natural fracture, abrasion resistance, structural interpretations with respect to economical removal and continued quantities, weathering characteristics and distance from project, all influence the practical value of any quarry site. Basalt rock, in most instances, answers the desirable requirements of road materials.

The westward extension of Columbia River basalts can be traced to within a few miles of Raymond and northward into the Grays Harbor region. It is the principal source of good highway materials in an otherwise barren area.