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# About Mechanisms of Bort Deformations and Benching Banks During Almalyk Ore Districtmining

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**ABSTRACT**:The article discusses the emergence of new stress state of rocks during mining and the formation of a number of deformations of the pit edges.It is noted that among those decisive values have gravitational slope deformations in the form of a landslide, ravel and flow of ground.All these types of deformation are observed during the development of large deposits of Almalyk ore district.As a result of the analysis of the deformation of the pit edges, the main conclusions are drawn, which can serve as the basis for the study and forecasting of landslide and other types of deformations.

**KEY WORDS:** landslide deformations, quarry, rupture zones, cracking, flow of ground, caving, landslides, talus, fault, tectonic cracks, shear flank quarry, slope stability, strength.

## I.INTRODUCTION

In spite of the fact, that the literature contains numerous descriptions of landslide and other bort deformations on the highwall of benching banks of various morphological types and scales, the mechanism of landslide bortdeformations in open pit mining of mineral deposits is still poorly studied [1; 2; 3; 4; 5 ; and etc].
In the quarries considered below, Kalmakyr and Sary - Cheku, mining depth and production capacity are increasing year by year, that cause large changes in the geological environment.In this regard, zones of unloading and redistribution of stresses in rock masses are formed in quarries.

The formation of sloping surfaces and the new stress state of rocks with the open pit mining of involved deposits creates conditions for the emergence of a number of deformations, among those the decisive meaning in the settlement of mineral resources has gravitational slope deformations.

The analysis about observations of deformation of the sides of the Sary-Cheku quarries and Kalmakyr deposits shows that all their morphological diversity (upper sides) represented by loesslike loams (Sary-Cheku) and strongly altered weathered igneous rocks (Kalmakyr) within the moss crushing zone by tectonic disturbances, a decrease was noted rock strength and landslide and other types of deformation as a result.The largest landslide with a rock mass of 591 thousand m2 occurred at the Sary-Cheku quarry in 2004 at a 1355m horizon. The mixture is involved in the rock mass (to the north) with a capture depth about more than 10 m, a width of 120-130 m, a length of 160 m.Further, the rock mass, in the form of a flow of ground, stretched westward to a horizon of 1115 m.The length of the flow of ground is 380 m, the width is 100-110 m.The hydrogeological conditions of the land deposit are favorable for mining, because groundwater lies very deep.Therefore, groundwater was not involved in the formation of this landslide.In the quarry, collapses on the escarpments of the ledges are widespread; they are associated with a crack in the fault zone.

## II. SIGNIFICANCE OF THE SYSTEM

The available material allows us to express some ideas on problem of the crack formation in the near-surface parts of the Sary-Cheku land deposit, composed of loess rocks, which were the natural boundary for the formation of a new stress state of rocks, creating conditions for a number of cracks on the surface of the loess mass along the pit side, that significantly reduces slope stability coefficient.A characteristic feature of such slopes is the penetration (i.e., infiltration) of spring precipitation through cracks and decompression along the entire prism of the collapse.The stability of such slopes depends on sliding capabilities at the stresses that are characteristic of them on this surface.Thus, the rock mass

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softening occurred due to flooding from the surface atmospheric water of the loess rock mass.In this case, a series of subparallel ground cracks formed.In addition, the formation of the cracks in the rocks along the side does not exclude the possibility of a dynamic quarry environment, in particular, seismic stresses during blasting operations carried out with the aim of loosening rock masses.Given the influence of the rate of application of gravitational loads, the only artificial source of the formation of such cracks in the rock massifs of ledges are seismic stresses.Such technogenic cracking in the instrument parts of the quarry also develops inherited, contributing to a clear manifestation of previously existing rocks, usually hidden from direct observation of cracks to their opening, increase in length.

## III. LITERATURE SURVEY

The mining of field of Kalmakyr has been hold for more than 60 years.During that period, there were a lot of different deformations (collapse, landslides, talus, flow of ground) with different volumes of rock masson the sides of the quarry.In all cases, the weathered igneous rocks of the rupture zones by tectonic disturbances and the associated zones of crack formation are involved in the mixing.The places of their formation are always confined to the areas of reduction in the strength of rock massifs.Visual observation showed that the cracks were mostly filled with clay and calcareous material.In weathered rocks, cracks are often less clear. A lot of weathering microcracks were noted, invisible to the naked eye, but contributing to the destruction of rocks under the influence of weathering.

Crushing zones of tectonic disturbances are characterized by low strength properties of rocks and a high degree of fracture.

The study of the nature of the deformation of large massifs of fractured rocks showed that discontinuous cracks did not affect the stability of slopes. As for continuous cracks of considerable length, their occurrence can have a decisive influence on the stability of slopes.Kalmakyrore reverse fault and Karabulak fault passing in the latitudinal direction within the design contour, Kalmakyr quarry is the largest weakened zone.A large tectonic block is formed between them, dissected by numerous faults of various directions of a smaller order into massive sections with different configurations of large cracks.
Landslides and talus will develop during field development, when discontinuous faults or large cracks develop parallel to the board and fall at angles of 30-60$^0$ towards the quarry bowl, landslide deformations.

The largest ravels will be confined to the weakened zones. Typically, the rate of shedding depends on a time factor, i.e. time for updating ledges, climatic factors and slope angles.

The most significant deformation occurred on the northwestern side of the Kalmakyr quarry in 2012.The process of deformation of the slope began after several days of raing, in the area of developed tectonic cracks of weathered igneous rocks.

## IV. EXPERIMENTAL RESULTS

The landslide deformations that appeared on the north-eastern side of Sary-Cheku open pit and on the north-western side of the Kalmakyr open pit show that in both cases the characteristic critical shear deformation occurred slowly, smoothly inside the open pit.In this case, as a rule, imbalances occurred in the rock mass and (Sary-Cheku quarry) and the structural strength of the rocks was overcome.Analyzing the landslide phenomena in the described deposits, three main conclusions can be drawn that should be the basis for studying and predicting the landslide process of loess rock strata of Sary-Cheku deposit and the mass of highly weathered fragmented igneous rocks of syenito-diorite Kalmakyr deposit.

Firstly, the shear resistance of an array of loess rocks with different mechanical properties with depth during joint deformation is less than the expected resistance, that can be defined as the weighted average of the ratio of the areas occupied by these rocks in the shear zone.This provision gives reason to believe that when calculating the stability of temporary sloping structures, it is necessary to introduce an amendment to the design characteristics depending on the degree of influence of moistening of the mass of loess rocks, and seismic stresses.It follows that under such conditions it is necessary to study the shear resistance on the wet mass of samples simulating the thickness of the rocks in the slope, taking into account seismic factors.

Secondly, in the crushing zones, the igneous syenite-diorite rocks of the Kalmakyr deposit, that have minimally low strength characteristics (adhesion 15-18 kg s / cm2, internal friction angle 28-31 °) and critical shear fracture strain, that are determined by the composition , structure, density, especially humidity, nature of structural bonds, stress state and

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dynamic environment (rock stress during blasting).The specificity of the conditions for the development of the process of deformation of the stratum on the pit side, presented here, makes it possible to re-evaluate the mechanism of landslide phenomena and, most importantly, improve the quality of forecasts in calculating the side stability, using not only the strength, but also the deformation characteristics of the rocks composing the sides of the quarries.

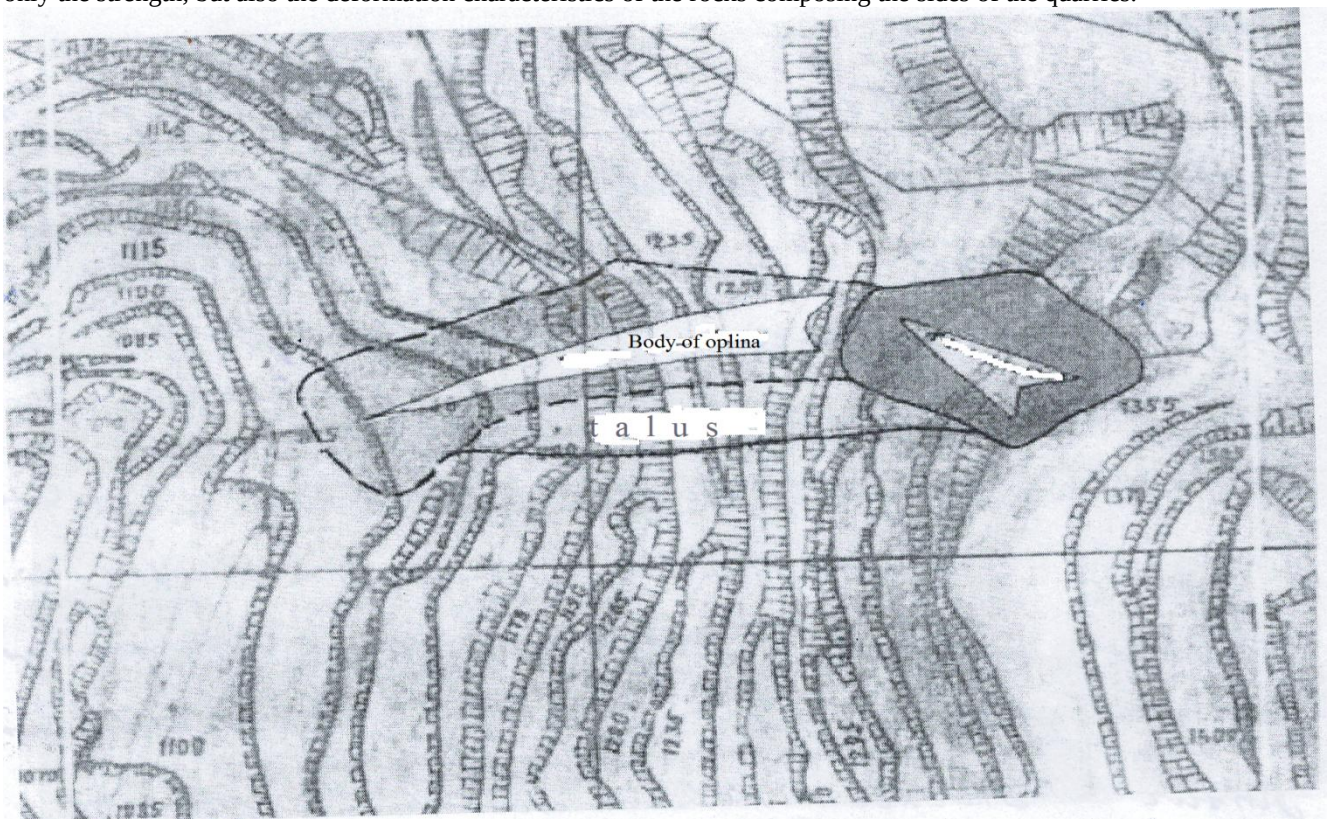


Fig. 1. Landslide deformation on the quarry of Sary-Cheku.

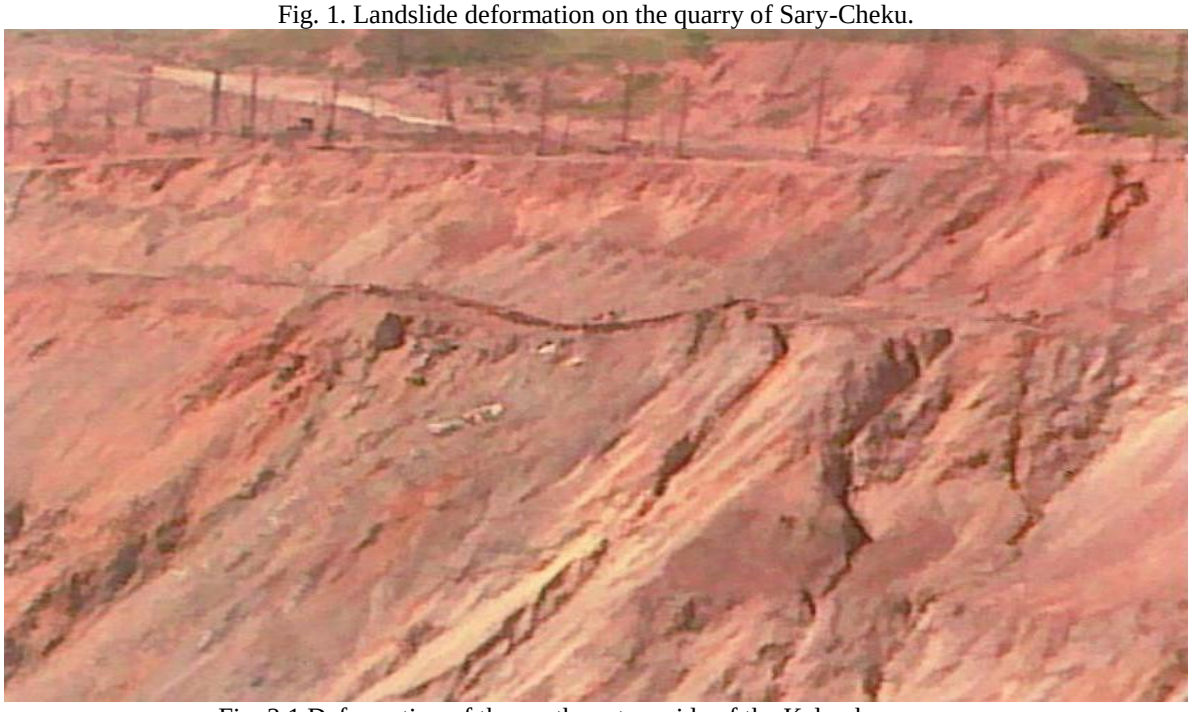

Fig. 2.1.Deformation of the southwestern side of the Kalmakyr quarry.

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Fig. 2.2.Deformation of the southwestern side of the Kalmakyr quarry.

It is necessary to identify one of the main questions about the leading factors that directly cause landslide deformations of the quarry sides.In our opinion, in our example, the main factors are the conditions under which the processes develop, under the influence of which the equilibrium conditions of the mechanical (seismic) forces participating in the process change.When studying the laws of occurrence and development of processes on the sides of quarries, no attention was paid to the factors which were described above.An analysis of the above factors shows that in the loess massifs that make up the sides of Sary-Cheku quarry and in the heterogeneous Kalmakyr massifs, slow mixing of rocks occurred over a fixed massif.The deforming array was mixed with respect to the fixed part along the sliding surface.This type of deformation is the largest in size of the exciting sections (Figs. 1 and 2.1;2.2).

Thirdly, among the mining factors that affect the stability of slopes of hard rocks (Kalmakyr deposit) and the value of the slope angles, the method of drilling and blasting is of the greatest importance.Under the action of a blast wave, the stress state of the array changes, which reduces the friction forces on the weakest surface and, with a small margin of stability, leads to sudden collapse of the side.The width of the cleaning berms and transport berms, the frequency of their location, as well as the type of exit, have a significant effect on the angle of inclination of the high sides composed of weathered igneous rocks and on the safety of work in a quarry. The stability of weathered rocks prone to softening is affected by the profile of the ledge sites, which ensures the flow of atmospheric waters. With the deepening of Kalmakyr quarry, according to engineering and geological information, an increase in the strength of the rock mass is noted. Therefore, the expectance of deformation of bort areas at great depths is reduced. Thus, as the depth of mining increases, it becomes possible to increase the slope angles of non-working ledges on deep horizons.

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