

## **Vertisols (as paleosols) with its related gigants land cracks as a disaster in central Iran deserts**

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### **ABSTRACT**

This paper discusses the genesis of land cracks and land depression as one of the clayey desert futures in Central Iran. The origin of this future has been issued after downfall of ground water pressure. The clay mineralogy showed that the swelling clays of smectite groups (like as beidellite) as vertisols can be mainspring for this limitation future in Central Iran. It concluded that pedogenesis in the paleoclimates was effective to form these smectite groups of minerals in paleosoils of Yazd, Central Iran.

**Keywords:** land cracks, land depression, vertisols, paleoclimates, desert futures, Central Iran.

### **INTRODUCTION**

The problem of land cracks and land depressions have been the most major limitation for land uses in Yazd (this region is an indicator for Central Iran) since technologic epoch. After water utilization like as irrigation from groundwater with engine and electrical pumps in deep wells more deficit of groundwater level to be resulted. The cracks and secondary depressions have relations with ground water deficits directly. Because of this relationship the first intentions were about groundwater pressure decreasing as major factors for land cracks and depressions. In this era the secondary cracks and depressions with affecting on land uses like agriculture, civil engineering, road constructions and so on, have played as a disaster with non clear origin in Central Iran. The landscape futures of Central Iran have drawn with early and late alluvial and flood depositions of quaternary. In this research we tried to detect the major factor of land cracks and land depressions from swelling clays in Yazd region. Whereas according to Gleen Borhardt (in chapter 14, smectites, Dixon and weed, 1989) the dioctahedral smectites, like as beidellites – may form as a result of weathering these minerals can be transformed from dioctahedral micas because those already have the tetrahedral substitution required for the beidellite structure, therefore these process can be occurred in soils of Yazd from past climates.

### **METHODS**

#### **Experimental**

The soil samples were collected from landforms with cracks (Pic. 1) and without it on the early and late depositions in Central Iran. The common soil properties were analyzed by routine methods. Clay mineral compositions and clay total elements were measured using XRD, DTA

and XRF methods. The coefficient of expansion (COLE) of the soils was calculated according to Keys to Soil Taxonomy (2006). Cation exchangeable capacity (CEC) of the soils was determined by sodium acetate and ammonium acetate. Exchangeable sodium percentage (ESP) of soils was measured by ammonium acetate and calculated with CEC.



Pic. 1: The land cracks in Yazd region, Central Iran.

### RESULTS AND DISCUSSION

The results of XRF analyses showed a change sequence of parent materials from early to late depositions. For example the percentage of Si oxides in late parent materials and soils differ from 48.46 to 56.11 but on the early depositions they differ from 20 to 35.9 percentages. The study of clay mineralogy and crystal-chemistry on the soils were done with XRD and DTA analyses. Clay mineralogy in the <1 micron particle size of the soils on the late depositions shows a decreasing sequence as illite(39.2-50.1%), palygorskite (17.2-37.9%), chlorite (8.7-16.7%), kaolinite (2.1-11.4%) and smectite (0.3- 5.4).The crystal-chemistry characters of The illites in clay fraction of late depositions show that they have formed from biotitic mica minerals in the soils. The clay mineralogy of early depositions and related parent materials and soils has completely different clay characteristics with maximum quantities of illite (with muscovite mica origin) and smectite like beidellite. According to MacKenzie(1970), muscovite DTA curves are characterize by two endothermic peaks at 800 to 900 ° C and about 1100 ° C that these peaks can be adapted to two endotherms of 708 and 1050 in the soil samples of A horizons of Yazd vertisols (curve a in figure1). Also MacKenzie(1970) reported one small hardly visible, exothermic peak at about 350 ° C from moscovite that may be compared with the exotherm at 293 ° C of the same Yazd soil sample. The wide exotherms from soil clay samples (figure 1) are partial related to residual organic maters that have been conserved by clays even after H<sub>2</sub>O<sub>2</sub>

treatments. The quantities of smectite group clays were increased in soil profile in the soil depth. According to Grim & Kulbiski(1961) the DTA curves of smectite show endotherms at temperatures < 300 °C reflect variations in adsorbed H<sub>2</sub>O and hydration of the exchangeable cations and the DTA of smectites forces rapid dehydroxylation, which occur at temperatures generally between 500 °C and 700 °C. The DTA of the soil samples of vertisols in Yazd showed two endothermic picks at 85 °C and 142 °C that they are related to adsorbed water and hydration of the exchangeable cations and an endothermic pick at 733 °C that it can be related to dehydroxylation of the clay(Figure 1, b). In 1945, Ross & Hendricks and in 1957 Mackenzie showed DTA curves of beidellite that it is almost the same of DTA curve b in figure1. The CEC of clays in vertisols profiles increase from 64.8 Cmole/kg in A horizons to 125.9 Cmol/kg in B horizons. The ESP of clays in vertisols changes from 20 to 60 in the A and B horizons respectively. The COLE in Vertisols arrive upper 0.33.

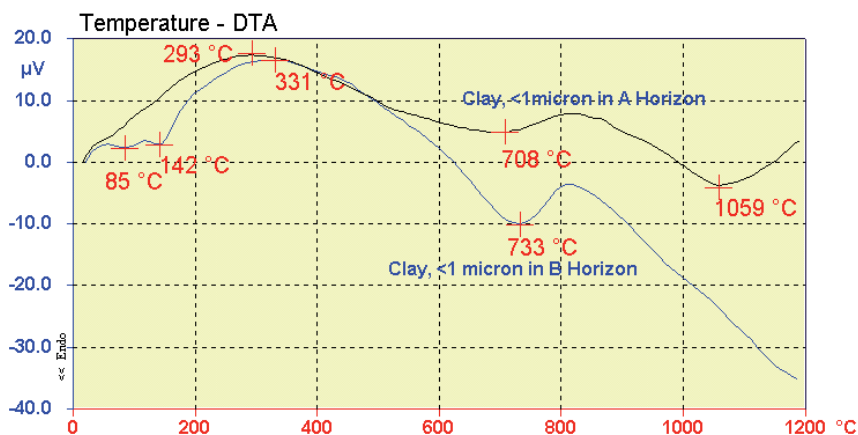


Figure 1: Differential thermal analyses of low smectite, illite clay a;(upper curve),in the A horizon and high quantity smectite b;(lower curve) in the B horizon from cracked landforms.

## CONCLUSIONS

The soils on the cracked landforms were classified as, Chromic Salitorrerts according to US-Soil Taxonomy(2006). Clay transformation from moscovite illite to smectite in soils of the vertisols can be acquired only related to paleoclimates when the moisture regime of the soils was very wetter than aridic soil moisture regime at now. As a result the land forms of Central Iran were affected by early depositions and past climates on the clayey surface and sub surfaces to form the Vertisols as Pale sols. With survey of soil geochemical and soil crystal chemical indices the potential of clayey lands of Central Iran can be classified in to risk (limitation) classes for different land uses.

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