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Environmental effects of changed land use on identification of clay minerals using X-ray diffraction

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Abstract

One of the most important issues that cause the threat of renewable natural resources and ultimately humans will be destroyed pasture vegetation and the waste of fertile. The use of land according to their suitability and capability within a proper management plan can reduce the damaged soil and restoration resources. The present study of land use changes in Aghcheh Fereidan in Isfahan province with 2000 hectares. Sampling was done in 0-30 cm soil depth in four land uses as natural Rangeland, Irrigation Farming, Dry Farming and abandon Dry Farming. The kind of clay minerals was identified by X-Ray Diffraction method (XRD) and the diffractograms was interpreted. The results show existence of minerals of Vermiculite, Illite, Kaolinite, Attapolygite and quartz in the soil of the region. This result also showed a logical sequence of Mica destruction is happening. Finally, change of land use in the study area shown, operations and cultivation and the destruction of natural rangelands, physical properties, soil chemical and mineralogy influence and eventually can reduce quality and increase soil degradation and its Consequences adversely in the long term to be followed.

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Introduction

X-ray diffraction (XRD) technique is the most heavily relied on technique, and the most powerful tool, in the identification of minerals. Especially in mixed-phase complexes, which is the usual situation met in the determination of clay minerals, the XRD has many applications. Mineralogical studies are very useful in determining the distribution of resources and the dispersion of minerals. Moore and Reynolds (1989) concluded from their research that among the methods of studying and identifying clay minerals (such as the XRD method, the differential thermal method, the infrared spectroscopic method, the scanning electron microscopy method (SEM), and the method of using chemical tests), the XRD method had the most applications in the identification of clay minerals. Identification of clay minerals can determine the relationships between mineralogical changes and changes in climate, land use, and in the intensity of weathering. Studying the characteristics of soil minerals and the way these minerals change and transform into each other helps to understand the chemical properties of soils and the origin of their fertility too (Olyaei *et al.,* 2009). On the other hand, clay minerals are components of all soils and the types of these minerals can significantly influence land use (Hartermink, 2006). That is why this research was conducted in an area situated 150 kilometers west of Isfahan where land use has changed and where there are four types of land use: rangeland, rain fed farmland, irrigated farmland, and abandoned rain fed farmland. Obtained diffractograms in the X-ray diffraction test indicated the presence of vermiculite, illite, Kaolinite, attapulgite, and quartz in the soils of the studied area and, to some extent, showed the logical sequence of the degradation of mica minerals.

Materials and methods

The studied area is located 150 kilometers west of Isfahan, forms part of the Aghcheh watershed, has an area of about 2000 hectares, is of the longitude 50◦ 02′ 13″ to 50◦ 05 56″ east and of the latitude 33◦ 03′ 34″ to 33◦ 07′ 25″ north, and has undergone great changes in land use during the past forty years. This area lies in the topography maps, with the scale of 1:50000, of Buin 6056III and of Boltaq (under number 5956II), and in the topography maps, with the scale of 1:25000, of block 57 of Golpayegan, paper numbers 6056III NW by the name of Noghan, Miandasht 6056III SW, Afus 6056III SE, Agha Gul 5956II SE and Great Qarah-Boltaq 6056III SW. It is bounded on the north by the Daran-Aligodarz road and the Zarneh hills, on the south by Afus and the Kolahgas Kuhe, on the east by Buin and Miandasht and the Aghcheh stream, and on the west by the continuation of Aghagul and Ghaleh Ekhlas heights. The Isfahan-Daran- Aznaveleh-Aghcheh asphalt road is the main access road to this area, and it takes about 50 minutes to drive from Daran to it. Most roads in the area are unpaved. Aznaveleh, Zarneh, Aghcheh, Hajj Fath Ali, Qaemabad, and Hezar Jareeb are the main Bakhshes (townships or districts) and villages in the area.

The linear sampling method was used to take samples from the depths of 0-30 centimeters in all four types of land use (rangeland, rain fed farmland, irrigated farmland, and abandoned rain fed farmland) in the studied area. Identification of minerals in the regions that had undergone changes in land use took place in four stages consisting of the treatments of soil samples before separating constituent parts, of separation of the constituent parts, of separated constituents, and of analysis of the samples by the XRD technique. A Siefert ID 3003 model XRD machine was used for this purpose at the central laboratory of the Sciences and Research Unit of the Islamic Azad University of Khuzestan, and the related diffractograms were drawn and interpreted.

Results and discussion

It is necessary to put the diffractograms of all four treatments of each tested sample beside each other and compare them to identify the types of minerals accurately. Figs. 1 and 2 shows the X-ray diffractograms of the various saturated treatments related to each land use. This X-ray diffractograms

show the results of the mineralogical study, which indicate the presence of vermiculite, illite, kaolinite, attapulgite, and quartz. Moreover, these results reveal the presence of the mixed-layer minerals of mica-vermiculite and illite-vermiculite. Another interesting result found in this study is the presence of a kaolinite that has been derived from degradation of primary minerals such as feldspars. Furthermore, clearly identifiable peaks with high intensities at 3.33 angstroms confirm the presence of quartz. The clay minerals illite and kaolinite are better observed in coarse clay, but montmorillonite can be seen in fine clay. In this connection, the conclusion drawn from most studies has been that coarse clays contain only two percent montmorillonite (Blanco and Stoops, 2007). Soil mineralogical studies and diffractograms obtained from X-ray diffraction test confirmed the presence of vermiculite, illite, kaolinite, attapulgite, and quarts in the soils of the studied area. Most Iranian researchers have reported the presence of quarts in their mineralogical studies (Gholami, 2010; Khademi and Khayer, 2004; Salehi *et al.,* 2003; Ajami, 2008; and Kaviani, 2008). The peak we obtained at 3.33 angstroms in the tested samples shows and confirms the presence of this mineral in the area.

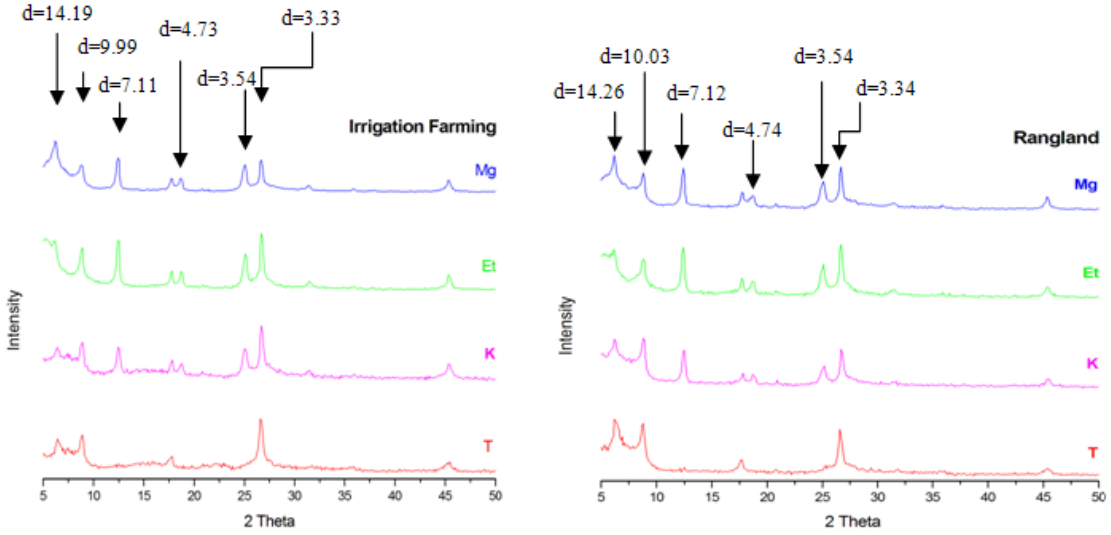

Fig. 1. X-ray diffractograms of various saturated treatments in rangeland and irrigated farmland

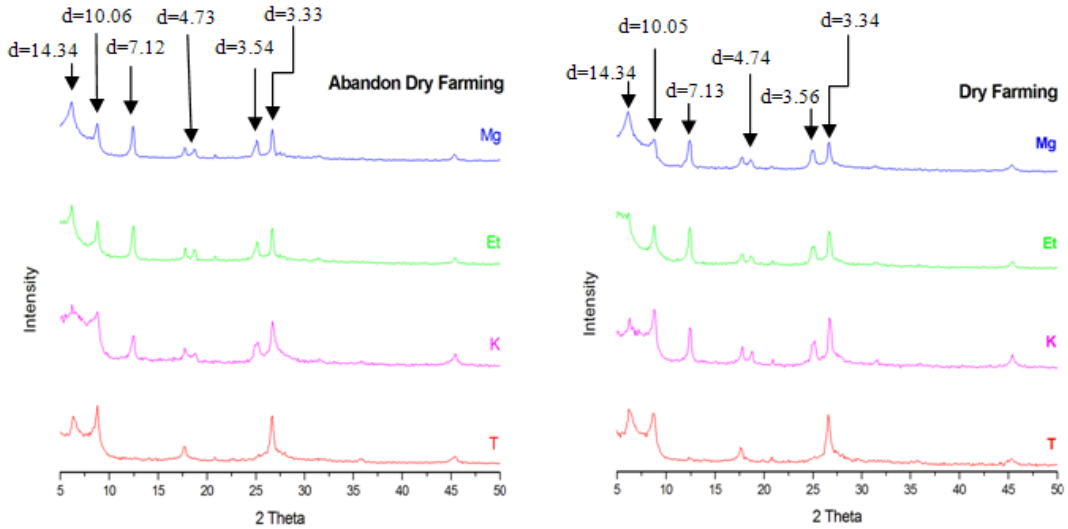

Fig. 2. X-ray diffractograms of various saturated treatments in rain fed and abandoned rain fed farmland

Gunal and Ransom (2006) studied various regions of Kansas using the X-ray diffraction method and identified smectite as the dominant mineral and concluded that its content increased with depth in that part of soils that contained coarse clay. They also found that the mica content in the part of soils containing fine clay decreased with depth, that calcium, sodium, and potassium feldspars were present only in the part of soils containing coarse clay and were absent in the part containing soft clay, and attributed the relative abundance of mica on soil surface to dust settling on the ground.

In general, our study of changes in land use in the area showed that farming operations and destruction of natural rangeland influence the physical, chemical, and mineralogical characteristics of soils, can eventually result in decreased quality and degradation of soils, and will have undesirable long-term consequences. In any case, it must be mentioned that any slight changes in land use and manipulation of the stable system that has evolved in forests and rangeland will entail very heavy damages.

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