MINERALOGICAL PROPERTIES OF OAK FOREST SOILS IN IRAQI KURDISTAN REGION*

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ABSTRACT

This experiment was conducted from 1/7/2016 to 20/12/2018 to study the mineralogical properties of oak forest at 12 locations (Gara, Matin and Brifca) from Dohuk governorate, (Bilah, Malakan and Awagrd) from Hawler Governorate, (Bardanga, Badawan and Chwarta) from Sulaimani Governorate, and (Bakhakon, Hawar and Sartak) from Halabja governorate in Iraqi Kurdistan region. The samples collected from a depth of (0 – 60) cm for laboratory analysis. The study includes qualitative identification of clay minerals by X- ray diffraction data. Peak height was used as a rough indicator of relative abundance of minerals. In general, the expansion of 14°A to ≈ 17°A in ethylene glycol treatment was not detected because the measuring was started from 5θ (degree 5 theta) so the differentiation between Chlorite and Semectite was not done in this treatment. The main results indicated that the swelling chlorite being the dominant mineral in these soils. While the miner clay mineral in that locations were Kaolinite. Mica was identified in all location except of Bilah site, the dominant type of Mica was Muscovite which was obtained from 6 Locations, while Biotite obtained from 5 sites. It appears that Muscovite was recorded from 50% of Forest sites while Biotite recorded at 41.7% of Forest sites and Both Mica mineral type was not recorded from 8.3% of studied Forest soils.

Keywords: clay minerals, X-ray diffraction, soil depth.

*** Part of Ph.D dissertation of the 1st author**

الصفات المعدنية لترب غابات البلوط في اقليم كردستان*

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المستخلص

تم تنفيذ هذا البحث خلال الفترة من 1 \ 7 \ 2016 الى 20 \ 12 \ 2018 لدراسة الصفات المعدنية ل 12 ترب غابات البلوط (طارة، متين و بريفكا)، (بله، ملكان و ئاوگرد)، (بەردانطة، باداوان و ضوارتا) و (باخةكون، هاوار و سرتك) في محافظات دهوك و اربيل و السليمانية و حلبجة \ اقليم كردستان على التوالي. تم أخذ النماذج في عمق (0 – 60) سم لتحاليل المختبرية. شملت الدراسة التشخيص النوعي لمعادن الطين باستخدام البيانات الخاصة بحيود الاشعة السينية. يدل ارتفاع القمة الى السياده النسبية للمعدن بصوره عامه لم يتم تدوين قراءة 14 – 17 أنكستروم في معاملة اثيلين كلايكول لان القراءات بدأت من زاوية (θ 5) لذلك لم يتم تمييز بين كلورايت، السمكتايت في ترب المدروسه. أشارت النتائج الى سيادة كلورايد و وجود الكاولينايت بحد الادنى في الترب المدروسة. تم تشخيص مايكا في جميع الترب عدا تربة بله و نوع السائد هو مسكوفايت حيث شخصت في 6 مواقع اما بايوتايت فلوحظت فقط في 5 مواقع. سجلت مسكوفايت و بايوتايت في 50 % و 41.7% من المواقع المدروسة على التوالي حين دلت النتائج الى عدم تواجدها في 8.3% من المواقع المدروسة.

الكلمات المفتاحية: معادن الطين، حيود الاشعة السينية، عمق التربة

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*Received:11/4/2019, Accepted:24/7/2019

INTRODUCTION

In arid and semiarid regions many oak species were growing. All of them are slow growing and stunted, there are many species of oak trees and the Valonia oak (*Quercus aegilops L)* is the common native species in Iraqi Kurdistan region, which is a medium sized deciduous tree. It is found on all kinds of soils but grows best on loamy soil in a dry climate and mountain areas with as little as 400 mm rain per year (8). Forest soils in north of Iraq are usually characterized by being shallow with some deep soils in the plains and valleys area. Forests are usually grown on non-covered rocks penetrated with some forest trees roots which lead to analysis and weathering of parent materials. So, the characteristics of such soils are highly dependent on the nature of the parent material consistent directly (20). The chemistry of clay and humus colloids determines soil's chemical properties. The very high specific surface area of colloids gives soil its great ability to hold and release cations (14). Osman (15) mentioned that, most elements are not generally found in pure elemental forms; they are bond in the minerals. There are a variety of primary minerals mostly associated with sand and silt fractions Quartz, Feldspar, Mica, Olivine, Pyroxene, Amphiboles, etc. and secondary minerals associated mostly with clay fraction Kaolinite, Montmorillonite, Vermiculite, Illite, Chloride, Halloysite, etc. The processes of disintegration and decomposition of minerals are done by weathering. Weathering of rocks and minerals is one of the most important processes operating at the surface of the earth, the exogenic system then transforms rock-forming minerals and their constituent elements into residual and secondary solids and dissolved products, and redistributes them physically, chemically, and biologically (18). Weathering also influences a variety of human activities, of particular interest here are mineral transformations during weathering which form soil minerals, releasing both essential nutrients such as K^+, Mg^{2+}, and Ca^{2+} and toxic elements such as Al^{3+} into terrestrial ecosystems and subsurface and surface waters (17). Land plants and their associated micro biota directly affect silicate mineral weathering in several ways: by generation of chelating ligands, by modifying pH through production of CO_2 or organic acids, and by altering the physical properties of a soil, particularly the exposed surface areas of minerals and the residence time of water (7). Clay minerals may be significant indicators of earth processes. They formed by hypogene processes result from the action of gases, vapors, or solutions that originate below and force their way upward through rocks of the earth's crust (11). The reviews of Millot (12) and Jackson (10) represent a convenient starting point with regard to the origin and formation of soil clays as assessed principally by the X-ray diffraction and microscopic technique that were available at the time. It has long been recognized that the minerals in the clay (2 µm) fraction of soils play a crucial role in determining their major physical and chemical properties, and inevitably questions concerning the origin and formation of these minerals have assumed some prominence in soil science researches (19). The term clay mineral is difficult to define, the definition that the JNCs have proposed is "phyllosilicate minerals and minerals which import plasticity to clay and which harden upon drying or firing (9). Silicate minerals can be altered by biological systems for example tree roots and microorganisms can alter mica by closing the release of potassium and other ions from the mineral lattices (5). This process is a combination of the replacement of the internal K^+ and structure multivalent ions in the Mica by H^+ ions from organic acids and the subsequent chelating of these released ions by organic acids (4). Akrawi (1) indicated to the effect of organic matter and inorganic fertilizer on the release of potassium from soil minerals in the soil cultivated with chickpea. Al-Hazaa (2) studied type of clay minerals in the north of Iraq for two different geological formations; the main clay minerals were Kaolinite, Illite, chlorite and Palygorskite. There are numerous investigations about studying mineralogical properties of forest soils conducted by (3, 13 and 16) but none of them included special type of forest and none of them covered all governorates for these reason this investigation was selected to study the mineralogical properties of Oak forest soils from Gara in Duhok to Sartak in Halabja.

MATERIALS AND METHODS

Before soil sampling, several trips were made to identify the representative sites. The trips emphasis done to select the suitable and representative Oak forests on one hand and to cover a wide spectrum of soil properties to the other hand, for this purpose, 12 sites were selected in Kurdistan region starting from Gara in Duhok to Sartak in Halabja as shown from Table 1 and Figure 1. Soil samples were air dried and passed through 2mm sieve. After that soil samples were stored in plastic bags prior to use. For the identification of clay minerals, the soil samples was treated by separating of clay fraction from other soil particles then removing of cement agents and saturation of clay fraction by (Mg^{+2} and K^{+}) cations. A number of XRD runs are made on differently pre-treated samples, for these purpose five slides prepared for each soil sample two of them from Mg^{+2} saturated part (Mg air dry and Mg saturated by glycerol) and three slide from K^{+} saturated part (K air dry and K treated withtemperature at (350 and 550)°C.

Table 1. Shows geographical coordinates of the sites from which the soil samples were taken

Governorate	Location	Latitude	Longitude	Altitude (m)
Duhok	Gara	37°01'40.24''	43°20'04.91''	1193
	Matin	37°04'51.73''	43°15'58.30''	955
	Brifca	36°48'32.89''	43°10'42.19''	778
Sulaimani	Bardanga	36°22'14.45''	44°44'56.71''	927
	Badawan	36°06'18.99''	44°44'16.64''	676
	Chwarta	35°42'42.40''	45°35'33.03''	1204
Hawler	Awagrd	36°13'34.36''	44°28'15.17''	903
	Bilah	36°50'55.76''	44°04'35.76''	511
	Malakan	36°28'24.60''	44°33'44.40''	1202
Halabja	Bakhakon	35°15'43.05''	46°06'34.75''	1143
	Hawar	35°09'51.03''	46°06'27.42''	1134
	Sartak	34°56'25.55''	45°46'43.32''	1195

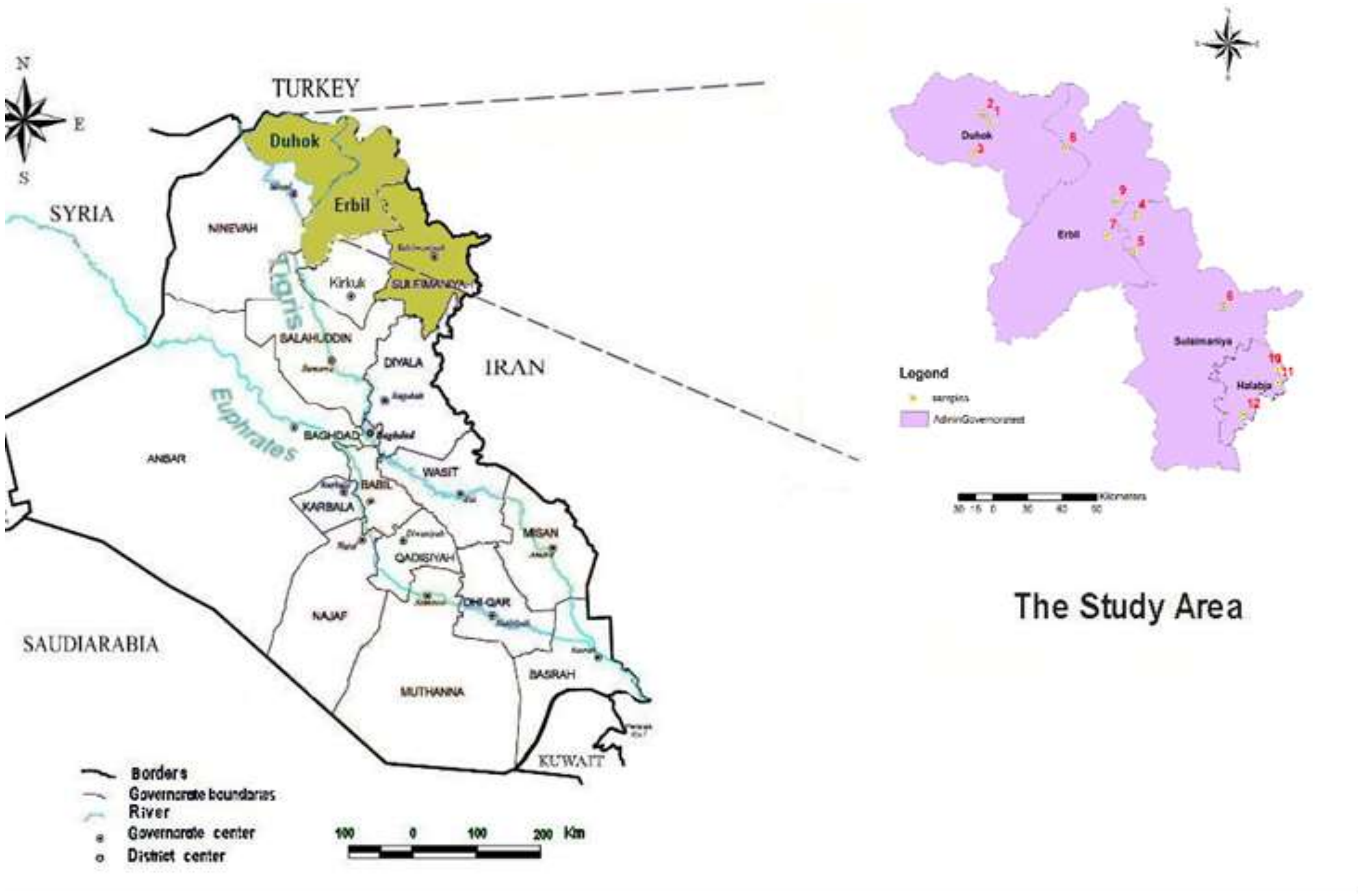

Figure 1. Explain the location map for the investigated sites

RESULTS AND DISCUSSION

Peak height was used as a rough indicator of relative abundance of minerals. In general, the expansion of 14°A to ≈ 17°A in ethylene glycol treatment was not detected because we start measuring from 5θ (degree 5 theta) sohat's why we cannot differentiated between Chlorite and Semectite in that treatment. The identification of dominant clay minerals depended on the peak height of Figures (2 to 5), In general, the swelling chlorite being the dominant mineral in the forest soils. The occurring of swelling chlorite in forest soils was due to deposition of hydroxy materials (Fe-Hydroxides or Mg-hydroxides) within the interlayer spacing of expansible layer silicate such as smectite. Dixon et al. (6) has observed that more frequently inter-layering is greatest in the surface horizon and decrease with depth. Mica minerals are identified by 10ºA reflection and it remains the same in all treatments. The distinction between Di-octahedral mica (Muscovite) and Tri-octahedral mica (Biotite) is based on the second order of d-spacing of mica. The second order for muscovite (5ºA) in Mg-saturated air-dry treatment was high and stronger than second order of Biotite. Kaolinite is characterized by 7ºA reflection and remain the same in Mg-saturation air dry, ethylene glycol-saturation, K-saturation air dry, and K-saturation 350ºC, while it disappears in K-saturation 550ºC in all sites. Swelling chlorite was donated at 9 locations of forest soils as shown in Table 2, it means that 75% of the forest soil samples recorded the highest swelling Chlorite content. The dominant Swelling Chlorite was observed from most of the studied locations except of Gara and Chwarta locations site which was Real Chlorite was dominant and Mica was dominant at Brifca site. The dominant clay minerals were Swelling Chloride, Real Chlorite and Mica-Biotite respectively. It means that 75%, 16.6% and 8.4%, while the miner clay mineral for the forest soils was Kaolinite. The Mica was exist in all location except of Bilah site which was not recorded, the dominant type of Mica was Muscovite which was obtained from 6 Locations, while Biotite obtained from 5 sites. It appears that Muscovite was recorded from 50% of Forest sites while Biotite recorded at 41.7% of Forest sites and Both Mica mineral type was not recorded from 8.3% of studied Forest soils. Non-clay minerals such as (Quartz and K-Feldspar) were recorded from all studied forest soils except Bilah site, the only non-clay minerals which observed at this site was Quartz. While the Dolomite was recorded from five forest soils which were equal to 41.7% of the studied forest soils. Depending on the obtained results the dominant clay mineral in oak forest soils were swelling chloride (75%), real chloride (16.6%) and mica (8.4%) the kaolinite clay mineral was recorded in all studied forest soils, while smectite group was not identified in this investigation because the starting point was (5 theta).

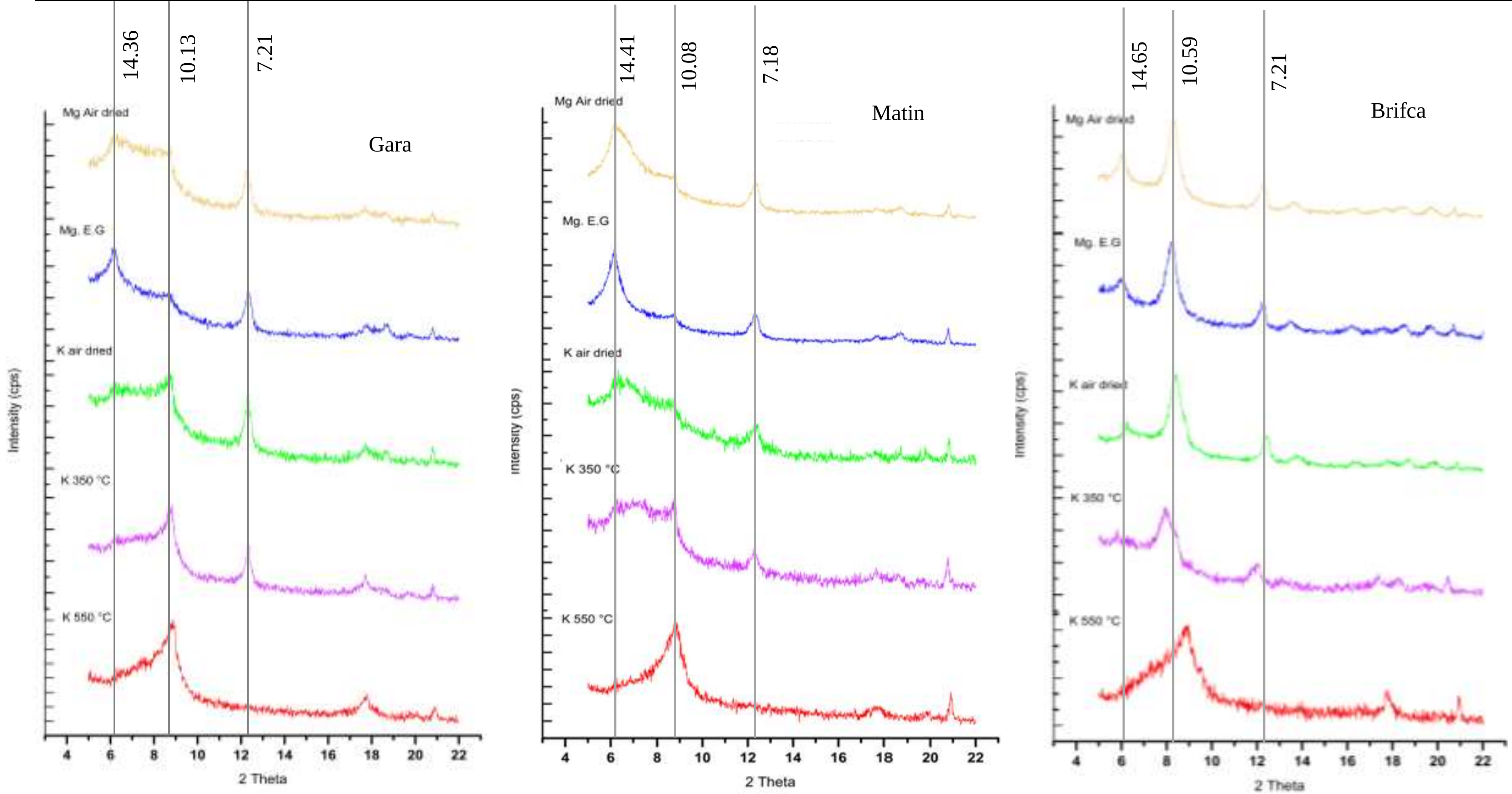

Figure 2. X-ray diffraction patterns for clay fraction in Duhok oak forest soils

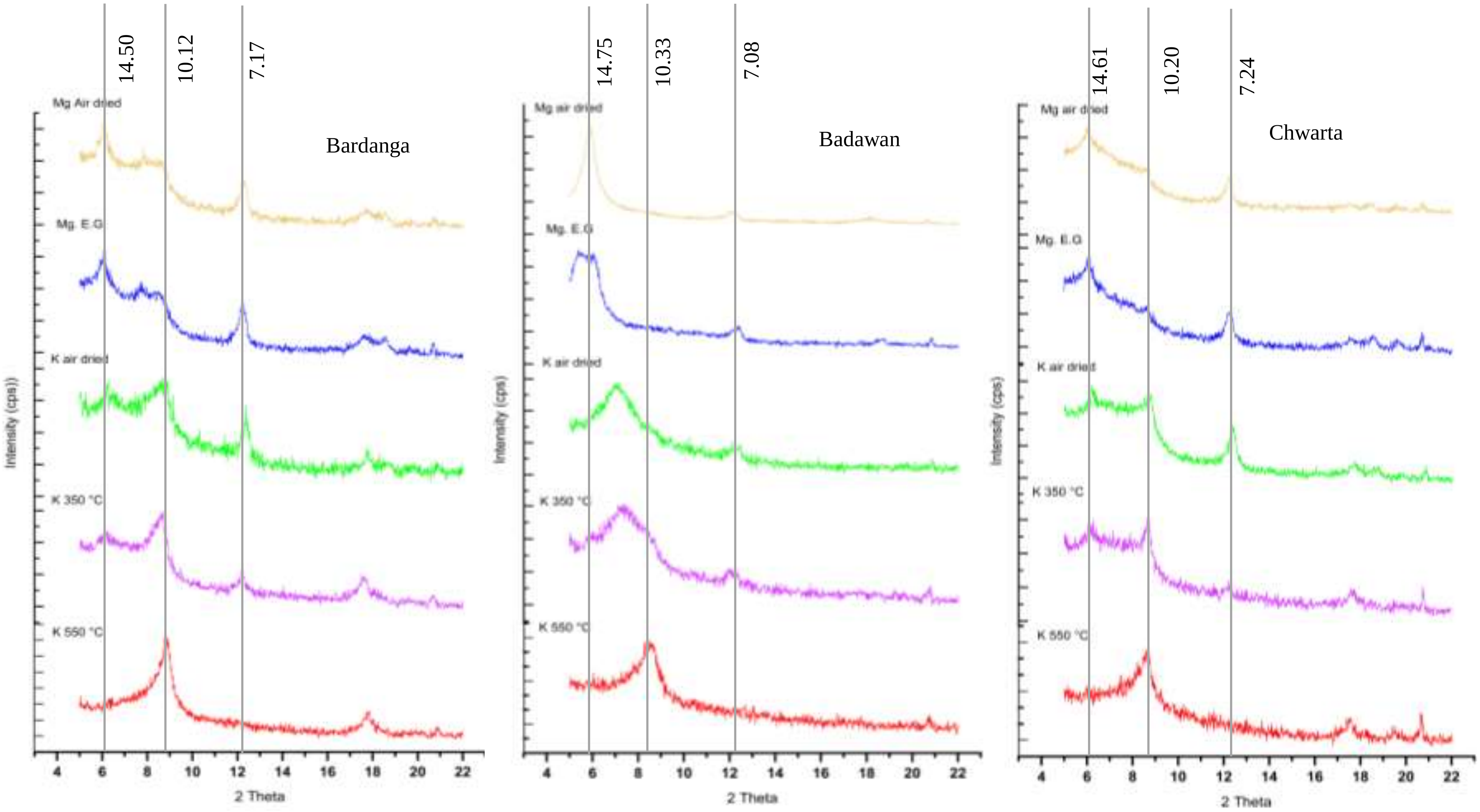

Figure 3. X-ray diffraction patterns for clay fraction in Sulaimani oak forest soils

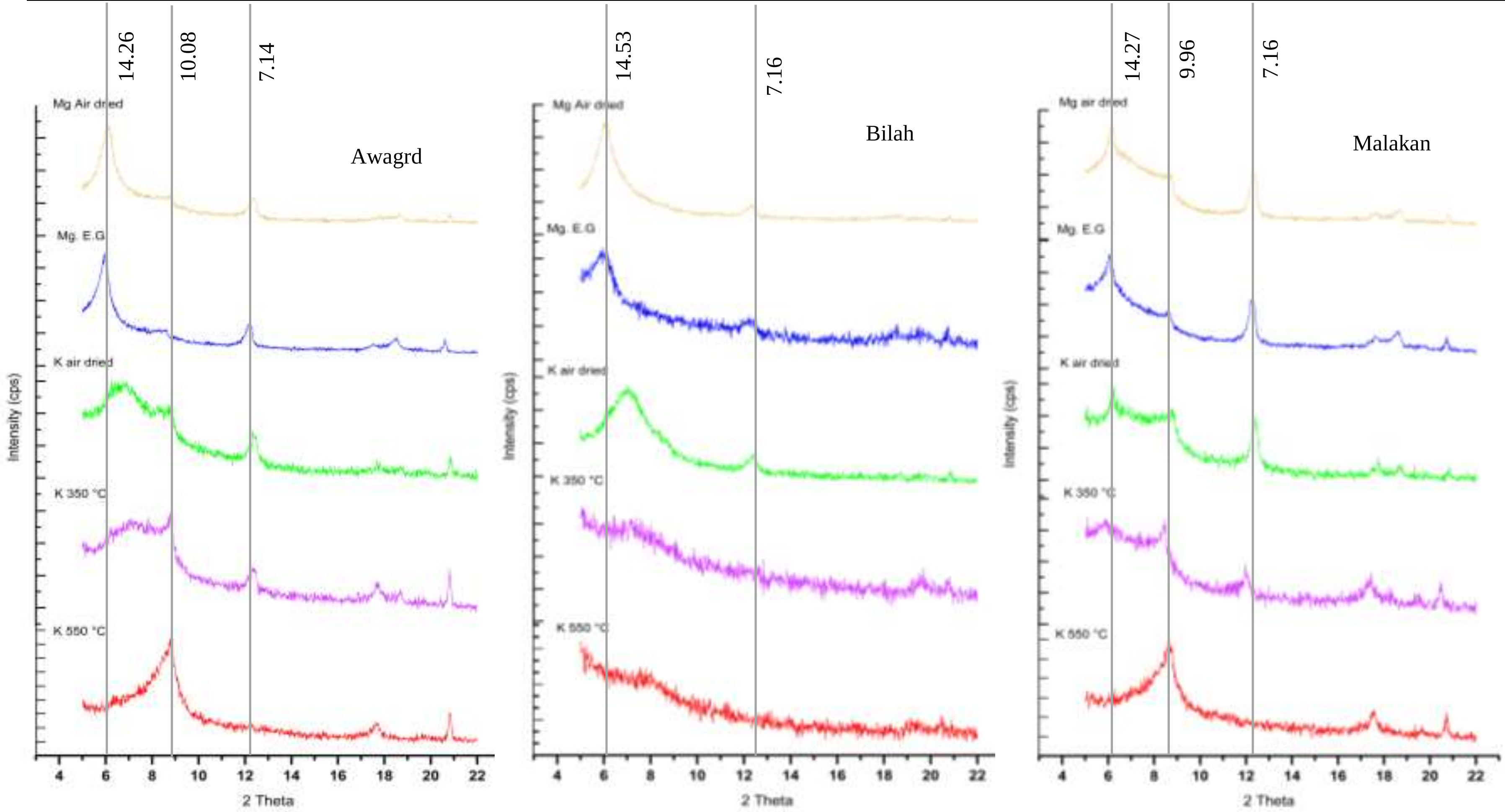

Figure 4. X-ray diffraction patterns for clay fraction in Hawler oak forest soils

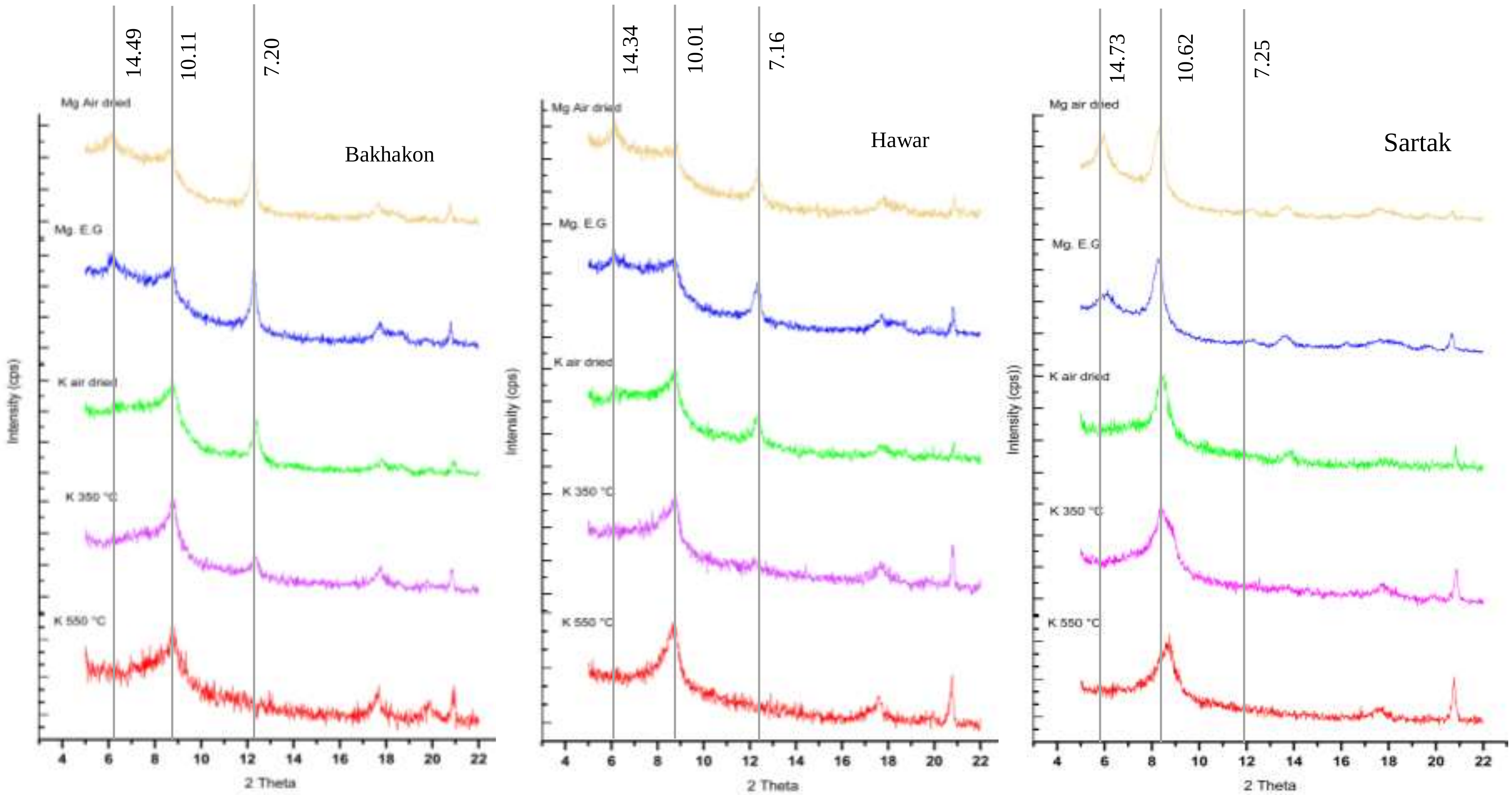

Figure 5. X-ray diffraction patterns for clay fraction in Halabja oak forest soils

Table 2 Shows the observed clay minerals in forest soil samples

#	Site	Swelling Chloride	Real Chloride	Mica	Kaolinite	Non-clay minerals
1	Gara	——	++++	+++ Muscovite	++	Quartz K-Feldspar
2	Matin	++++	——	+++ Biotite	++	Quartz K-Feldspar
3	Brifca	+++	——	++++ Biotite	++	Quartz K-Feldspar
4	Bardanga	++++	——	+++ Muscovite	++	Quartz Dolomite K-Feldspar
5	Badawan	++++	——	+++ Biotite	++	Quartz Dolomite K-Feldspar
6	Chwarta	——	++++	+++ Biotite	++	Quartz K-Feldspar
7	Awagrd	++++	——	+++ Muscovite	++	Quartz Dolomite K-Feldspar
8	Bilah	++++	——	——	++	Quartz
9	Malakan	++++	——	+++ Biotite	++	Quartz K-Feldspar
10	Bakhakon	++++	——	+++ Muscovite	++	Quartz Dolomite K-Feldspar
11	Hawar	++++	——	+++ Muscovite	++	Quartz K-Feldspar
12	Sartak	++++	——	+++ Muscovite	++	Quartz Dolomite K-Feldspar

Dominant ++++ 50 – 90%
Major +++20 – 50 %
Minor ++ 5 – 20 %
Trace + < 5%
Non-clay minerals detected

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