

Comparison of mineralogical properties of highland peat and peat swamp forest; Case study: Ziarat PSF and Ghaleh-ghafeh PS

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ABSTRACT

In this study, we compare the mineralogical properties of two different kind of Peat and Swamp. To achieve this goal, Samples from a highland peat and a peat swamp forest in Golestan Province, have been considered. These studies were carried out using thin sections, XRF, and XRD. Quartz, muscovite, biotite, pyroxene, and Fe in forest swamp and Fe-Mn component, Quartz, aluminum and clay in high land peat are composed mainly mineral. Result shows the concentration of aluminum and quartz in highland peat swamp and the concentration of sodium, sulphur, calcium and L.O.I in peat swamp forest is more.

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Introduction

Peat can be define as an organic soil which is formed by the accumulation of decayed vegetative matter that has formed in areas of poor water drainage [1]. Fens and swamps are usually anaerobic, sulphidic and neutral to alkaline in pH [2]. The mineral components of peat are derived from inorganic matter contained in sediments and by adsorption from groundwater [3]. The inorganic fraction of peat usually accounts for only 2 to 10 % of the dry weight of the sample. For the highly decomposed mucks this can increase to about 60 % of the dry weight [4]. The inorganic composition of peat varies considerably from region to region [5]. The mineral composition of ombrotrophic peat is rather simple and uniform with depth. For example, the ash from Etang de la Gruère peat bog (Jura Mountains, Switzerland) contains mainly quartz (60– 90 %) and opaline silica (30–70 %) with fewer amounts of feldspar (5–15 %) and layered silicates, mainly muscovite (5–15 %) [3].

In general the total inorganic content of the peat (which is usually expressed in terms of the ash content of the sample) is greatly influenced by the following two factors; 1) the relationship between the peat deposit and the local water table and 2) the state of decomposition of the peat [5].

Thin sections of peat reveal detailed information of composition, structure, fabric [6]. The mobility of metals in swamps is related to fulvic acids and low molecular weight compounds, for instance, ligands, while humic acids are the major factor in the formation of stable organo-mineral complexes [7].

This paper deals with the mineralogical characteristics of peat and swamps soils in Golestan Province, North of Iran. The objective of this study was to compare, through the use of thin sections, mineralogical properties of two types of peat and swamps. To achieve this purpose, we focused on two case studies consisting of a peat swamp forest (*Suteh PSF*) and a highland peat swamp (*Ghaleh-ghafeh PS*). In the present paper, we have applied an approach, consisting of X-ray

fluorescence techniques, thin section microscopy study and X-ray diffractometry (XRD) to study the geochemical and mineralogical properties of peat and swamp samples. We examined some of the major and trace elements area of an approximately 40 cm core collected in the study areas in Golestan Province, North of Iran to compare these peat and swamp.

Study area

This paper focuses on two study areas with different ecological conditions that are located in Golestan province North of Iran (**Fig. 1**). Golestan Province is the third largest cereal producer in Iran but scarcity of water and salinity are most important major problems in this area [8]. Golestan Province has been covered by almost 400,000 hectares of forests. Lakes in Golestan Province have an important influence on economic and routine aspects of life of vernacular people.

Suteh PSF

Suteh PSF is located in Ziarat jungle, the southern part of Golestan province (Fig. 1, No.1). This area is located in the north mountainside of the Alborz Mountains and from the North it extends to Gorgan. There are no specific topographical features except edges and valley in the Ziarat. The altitude of the region is approximately 950 meters from sea level. According to the Emberger climate diagram, climatic conditions of this region are temperate and semi-arid. Annual rainfall is approximately 520 mm and the annual mean temperature is approximately 18 °C. Two stratigraphic units play a major role in the lithology of Ziarat: the Precambrian and Mesozoic sediments. Precambrian sediments mainly composed from metamorphic schist (mica schist, chlorite schist, quartzite, marble and slate), which is dark green and bright is the known Gorgan green schist. Mesozoic sediments consist mainly of limestone and dolostone with layers of marl in the upper Jurassic. In some places there are sandy loose Quaternary sediments.

Ghaleh-ghafeh PS

Ghaleh-ghafeh PS is a highland peat swamp that is located in the southeastern part of Golestan province around Minudasht city (Fig 1, No.2). This seasonal swamp is used as pasture for livestock. The elevation of the study area ranges from 100–2,500 m above sea level. The climate of Minudasht is temperate and mountainous type at heights, while in the plains, temperate and semi-humid climate prevails. In this way, mean annual precipitation within the study area varies from 138 to 335 mm [9].

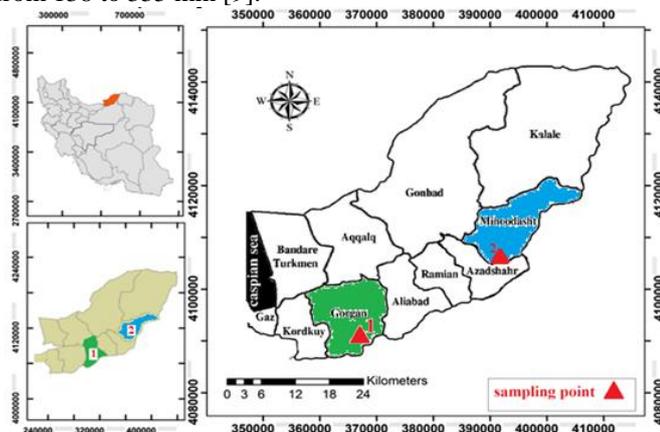


Fig.1. Map of study area

Sampling and analysis

Samples were collected during spring from various locations around all swamps. Samples collected in swamp areas in April, 2014, from 0 to 40 cm deep, 10 cm diameter were excavated with a hand trowel.

Samples were dried to constant mass at 110°C and then pulverized in a swing mill. Micromorphological method of analysis originally evolved from the study of soil, where the practice of casting soil samples in resin and then examining them microscopically has been used since the 1950s [10]. This technique has been applied to deposits from archaeological sites since the 1970s [11]. To prepare thin sections for microscopy studies, samples with polyester, cobalt oxide and hardener have been combined. Polyester formed the matrix of the section and hardener (HCl + H₂O₂) has been used to reduce a hard time getting. Cobalt oxide has been used as a catalyst between them. Samples have been kept tight in special containers. Due to the presence of organic matter, much time is needed to harden them. Samples were dry and tough for 20 days. Then the samples were polished by various polishers (No. 400, 600, 800, 1000 and 2000). Then they were polished for 20 minutes by the suspension of alumina (Al₂O₃ + H₂O). Micromorphological studies were carried out polarized microscope Olympus model (at the Mineralogy Laboratory of the Amirkabir University of Technology) using thin sections, which were prepared via standard procedures.

Results and Discussion

X-ray fluorescence

X-ray fluorescence (XRF) has been used to determine geochemical composition of material as an inexpensive, non-destructive, and rapid technique. Table 1 compares the amount of elements found in the samples from Suteh PSF and Ghaleh-ghafeh PS. It can be seen from the table that the amount of a particular inorganic species present varies considerably between regions. The concentration of aluminum and quartz (silicate minerals) in highland peat swamp is more than forest peat swamp. However, concentration of sodium, sulphur, calcium and amount of organic matter in peat swamp forest is more than highland peat swamp. Several parameters can influence these differences are as follows: Geological setting, climate condition, hydrological aspect and land use. Although

there are some different, concentration of some parameters in these area are same.

X-ray diffractometry

We have applied X-ray diffractometry (XRD), to study the structure and properties of typical Suteh PSF and Ghaleh-ghafeh PS samples. Detailed examination of the mineralogy of the samples using XRD has been shown in Fig. 2. The XRD of the Suteh PSF at a depth of 15cm (Su-15) revealed mineral characteristics with the presence of quartz mineral and clay material (Montmorillonite). The XRD of the samples at a depth of 20 (Su-20) revealed the large presence of the quartz mineral. The XRD of the sample at a depth of 40 cm (Su-40) revealed mineral characteristics with the presence of quartz mineral, Anorthite, Calcium carbonate (Calcite), Chloritoid and Montmorillonite. The XRD of the Ghaleh-ghafeh PS at a depth of 10cm (Gh-10) revealed mineral properties with the presence of quartz mineral and Aluminum silicate (e.g. Kyanite). The XRD of the Ghaleh-ghafeh PS at a depth of 20cm (Gh-20) revealed mineral properties with the presence of quartz mineral and Calcium Aluminum silicate (e.g. Anorthite).

Thin section study

A polarized microscope Olympus model (at the Mineralogy Laboratory of the Amirkabir University of Technology) has been used for the microscopy analyses of the samples.

Mineralogical studies of Suteh PSF indicated that the samples have a sericitic background (Sr) with a subhedral granular texture and porphyritic fabric. Mineral assemblages include anhedral to subhedral Quartz (Qz), anhedral to subhedral Orthoclase (Or), subhedral Muscovite (Mus), subhedral Biotite (Bi), anhedral Calcite (Ca), opacity Pyroxene (Px) and opaque minerals. The Fe component is most common in the opaque minerals. Quartz crystals have been seen in abundance in most sections. Orthoclase is seen in some sections that have weathered surfaces. Large biotite crystals have been seen at different sections with pleochroism of light brown to dark brown. Some section of the Suteh PSF samples have been shown in Fig. 3.

Results of thin section study of Ghaleh-ghafeh PS shown that the coarse material forming is composed of quartz, clay, biotite and opaque minerals. Fe–Mn nodules are most common opaque minerals. Small quartz particles have seen overmuch in the section. Some section of the Suteh PSF samples have been shown in Fig. 4.

Table 1. Comparison of Suteh PSF and Ghaleh-ghafeh PS

	Su-40(wt. %)	Su-20(wt. %)	Su-15 (wt. %)	Gh-10 (wt. %)	Gh-20 (wt. %)
Na ₂ O	0.06	0.05	0.07	0.31	0.28
MgO	1.63	1.4	1.32	1.78	2.1
Al ₂ O ₃	5.93	2.95	3.89	9	11.3
SiO ₂	41.9	20.6	31.3	56.4	48.9
P ₂ O ₅	0.29	0.35	0.26	0.25	0.18
SO ₃	1.58	0.93	1.48	0.3	0.24
Cl	0.05	0.02	0.02	0.01	0.03
K ₂ O	1.85	0.85	1.25	1.88	2.2
CaO	7	9.5	6.5	1.3	1.95
TiO ₂	0.77	0.35	0.52	0.9	0.74
V ₂ O ₅	0.03	0.01	0.01	0.028	0.01
Cr ₂ O ₃	0.01	0	0.02	0.018	0.015
MnO	0.09	0.08	0.07	0.055	0.09
Fe ₂ O ₃	5.5	2.64	3.9	4.8	5.2
Rb ₂ O	0	0	0	0.013	0.01
SrO	0.03	0.02	0.02	0.02	0.02
L.O.I	33.23	60.23	49.35	22.914	26.715
Sum	0.05	0.02	0.02	0.022	0.02
La-Lu					

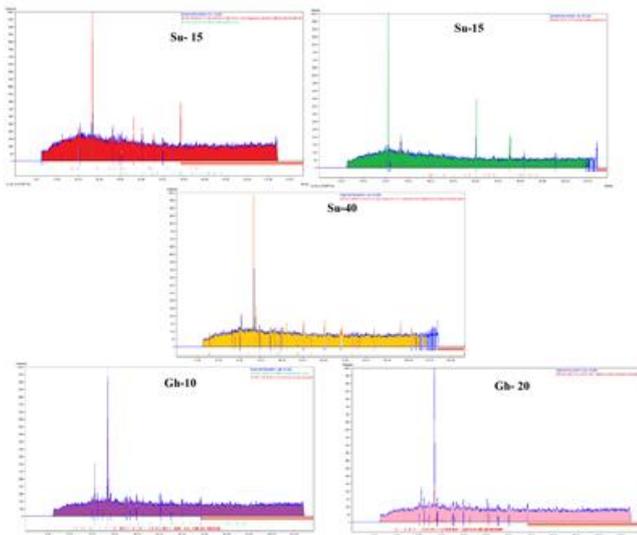


Fig 2. XRD results at different depths in Suteh PSF and Ghaleh-ghafeh PS

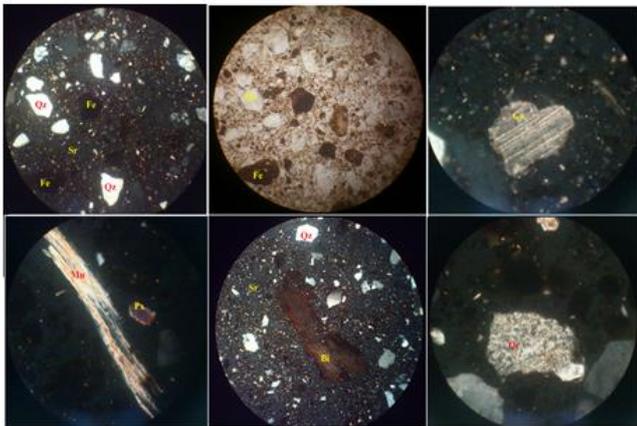


Fig 3. Thin sections of Suteh PSF samples

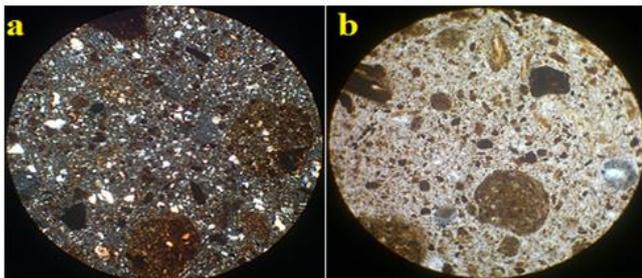


Fig 4. Ghaleh-ghafeh PS sections, Fe-Mn component, Quartz and Clay in sericitized background

Conclusion

In this study, mineralogical properties of Suteh peat swamp forest and Ghaleh-ghafeh Peat Swamp in Golestan Province, North of Iran have been investigated. The results of compare these ecological studied area are as follows:

- It is shown that Majority of the minerals are most likely primary minerals inherited from the parent material due to negligible chemical weathering.
- Based on the XRD of Suteh PSF, at a depth of 15cm mineral characteristics with the presence of quartz mineral and clay material (Montmorillonite) were revealed and at 20 and 30

cm depth the large presence of the quartz mineral was revealed. At a depth of 40cm, mineral characteristics with the presence of the quartz mineral, Anorthite, Calcium carbonate (Calcite), Chloritoid and Montmorillonite were revealed.

- Based on the XRD of Ghaleh-ghafeh PS, at a depth of 10 cm mineral characteristics with the presence of quartz mineral and Aluminum silicate (e.g. Kyanite) and at a depth of 20cm revealed mineral properties with the presence of quartz and Calcium Aluminum silicate.
- The concentration of aluminum and quartz (silicate minerals) in highland peat swamp is more than forest peat swamp but, the concentration of sodium, sulphur, calcium and L.O.I in peat swamp forest is more than highland peat swamp.
- Microscopy studies in thin sections examined mineral assemblages of Suteh PSF including quartz, orthoclase, muscovite, biotite, calcite, opacity pyroxene and Fe components and minerals of Ghaleh-ghafeh PS consist of coarse forming quartz, clay, and biotite and Fe–Mn nodules.

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