



Micromorphological and mineralogical Features of Peat and Swamp in Golestan Province; North of Iran

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Abstract

In this study, we focused on detailed studies on micromorphological and mineralogical properties of three types of Peat and Swamp, to compare these different ecological area together. To achieve this goal, Samples from a highland peat swamp (*Ghaleh-ghafeh PS*), a peat swamp forest (*Suteh PSF*) and a costal swamp (*Galougah CS*) in Golestan Province, North of Iran have been considered. These studies were carried out polarized microscope using thin sections. Quartz, muscovite, biotite, pyroxene, and Fe-Mn component are composed mainly soil materials. Most common opaque minerals in samples of all studies area were consisted Fe-Mn component. Root and other organ residues in some sections of Suteh PSF have been seen. Oyster or limpet just have been seen in Galougah CS sections. Fe-Mn component were most common that may be indicates mixing of soil material Root and other organ residues in Suteh PSF shows this soil composed of a mixture of organ residues and organic material. Presence of oyster or limpet in Galougah CS sections may be related to location of this swamp.



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Introduction

Peat is an organic soil which is formed by the accumulation of decayed vegetative matter that has formed in areas of poor water drainage (Delicato, 1996). The depth of a peat deposit can vary considerably, from as little as 30 cm (the minimum thickness of peat soil required for the area to be classified as a bog) to depths in excess of 50 to 70 m (Leson & Winer, 1991). The mineral components of peat are derived from inorganic matter contained in sediments and by adsorption from groundwater (Steinmann & Shotykh 1997), so that the source of water significantly influences peat geochemistry (Malawska & Wilkomirski 2004). 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 (Leson & Winer, 1991). The inorganic composition of peat varies considerably from region to region (Dalouche et al. 1981).

The study of soil organic matter is necessary for solving many problems related to the rational use of soil resources, the prediction of the consequences of technopedogenesis, and the creation of theoretical bases of soil monitoring (Grüneberg et al, 2010; Lorenz & Lal, 2009)

In the tropical belt a wide range of climatological, geological and geomorphological situations can be found, including humid, semi-arid and arid environments as well as mountainous areas (Stoops et al. 1993). The structural differences between peat types are generally associated with fibrous composition such as reed peat, sedge peat and the most common, *Sphagnum* moss peat (Dachnowski-Stokes, 1941). Thin sections of peat reveal detailed information of composition, structure, fabric (Lee, 1983) and particularly pore properties which influence water retention and movement. Micromorphology is simply a microscopic technique for collecting particular kinds of data on soil materials and profiles (Brewer, 1972). Micromorphological methods make it possible to assess the initial changes in the soil fabric under the influence of urban pedogenesis (Gerasimova et al. 2003; Prokof'eva et al, 2001). Micromorphology has been shown to be a very powerful tool in the assessment of pedogenesis (Igwe, 1989). Micromorphological analyses allow the characterization of natural and anthropogenic sediments, which in turn makes possible

the evaluation of the site formation processes and the environment in which the deposits were formed (Ismail-Meyer, 2014). Since the early 1990s, micromorphological studies have become increasingly popular in the analysis of lakeside settlements (Wallace 2000, 2003; Karkanis et al. 2010). Soil micromorphology is available to characterize SOM variability at the scale of materials (Poch & Virto, 2014). The interpretation of micromorphological features has been based essentially on comparison between thin section observations, macromorphological features and laboratory data. Interpretation can also be based on experimental work in the laboratory or in the field, or on field observations (Stoops, 2010).

This paper deals only with the micromorphological 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 three types of peat and swamps. To achieve this purpose, we focused on three case studies consisting of a peat swamp forest (**Suteh PSF**), a highland peat swamp (**Ghaleh-ghafeh PS**) and a coastal swamp (**Galouga CS**).

Materials and Methodology

Study area

This paper focuses on three 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 (Kurdi et al., 2014). 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. Fig. 2a shows an image of Suteh PSF. 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. Fig. 2b shows an image of Ghaleh-ghafeh PS. 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 (Roodposhti et al. 2012).

Galougah CS

Galougah CS is a coastal swamp that is located on the southern part of the Caspian Sea, near the Qareh Sou Basin and Gorgan Gulf (Fig 1, No.3). Gorgan Gulf has been covered nearly four hundred square kilometres in the southwest of the Golestan Province. Special ecosystem of this area has vital impact on natural environment of many migratory bird and cartilaginous fish. Fig. 2c shows an image of Galougah CS.

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 (Babel 1975). This technique has been applied to deposits from archaeological sites since the 1970s (Goldberg and Macphail 2008). 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.

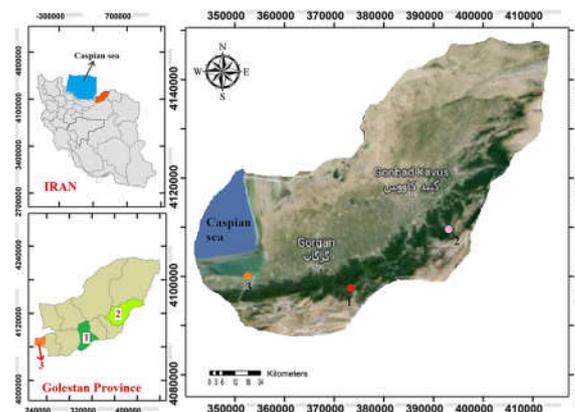


Fig. 1. The map of Golestan province North of Iran; sampling stations located on the basin map

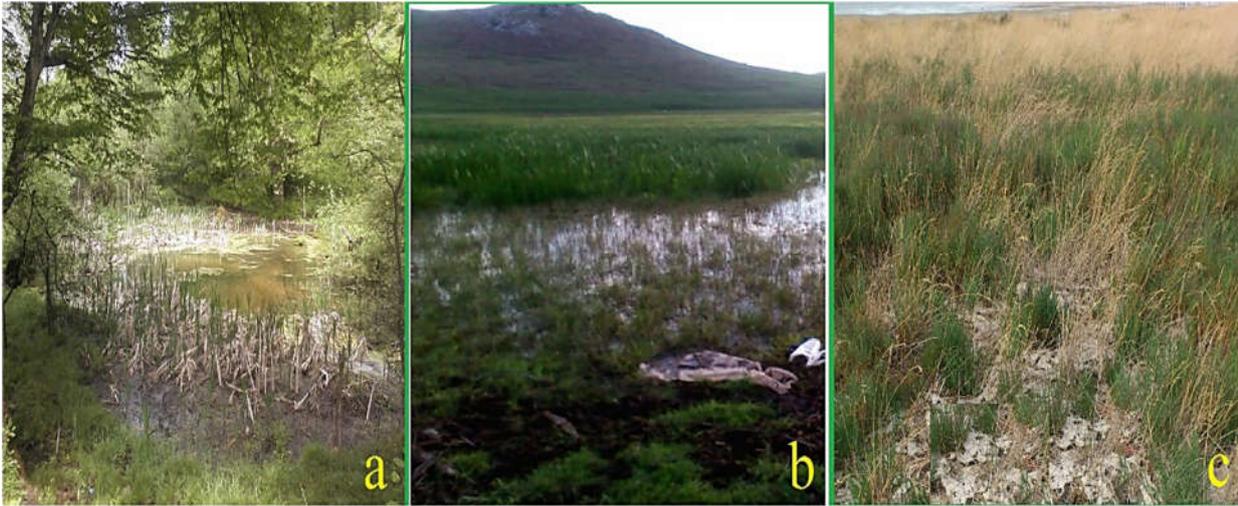


Fig. 2. Study area picture; a) Suteh PSF, b) Ghaleh-ghafeh PS, and c) Galougah CS

Results

Such mineral composition of the soils studied is connected with a high diversity of rocks occurring in the studied area (Majka et al., 2010). The coarse material forming groundmass is composed of quartz, muscovite, orthoclase, calcite, opacity pyroxene biotite and opaque minerals. Some flakes of muscovite, pyroxene and biotite show weathering (Fig. 3 & Fig. 4). Fe–Mn component are most common opaque minerals. Quartz crystals have seen in abundance in most sections. Weathered surface of orthoclase has been seen in some sections (e.g. Fig.3.c & d). Large biotite crystals at different sections with pleochroism light brown to dark brown have seen (e.g. Fig.4. c & d). A mica layers and iron segregations occurred in the section (Fig. 5. c). Root and other organ residues in

varieties states of decomposition are in some sections of Suteh PSF (Fig.5. d). Fragments of organ and tissue residues are rather few and found mostly in the surface of Suteh PSF (Fig.5.a & b).

Micromorphological studies 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 (Fig.6).

Micromorphological studies of Galougah CS indicated that the sections consist many Oyster or limpet with high order interference colors and some Fe component and quartz (Fig.7). In addition, a few high relief pyroxenes have been examined (Fig.7. d).

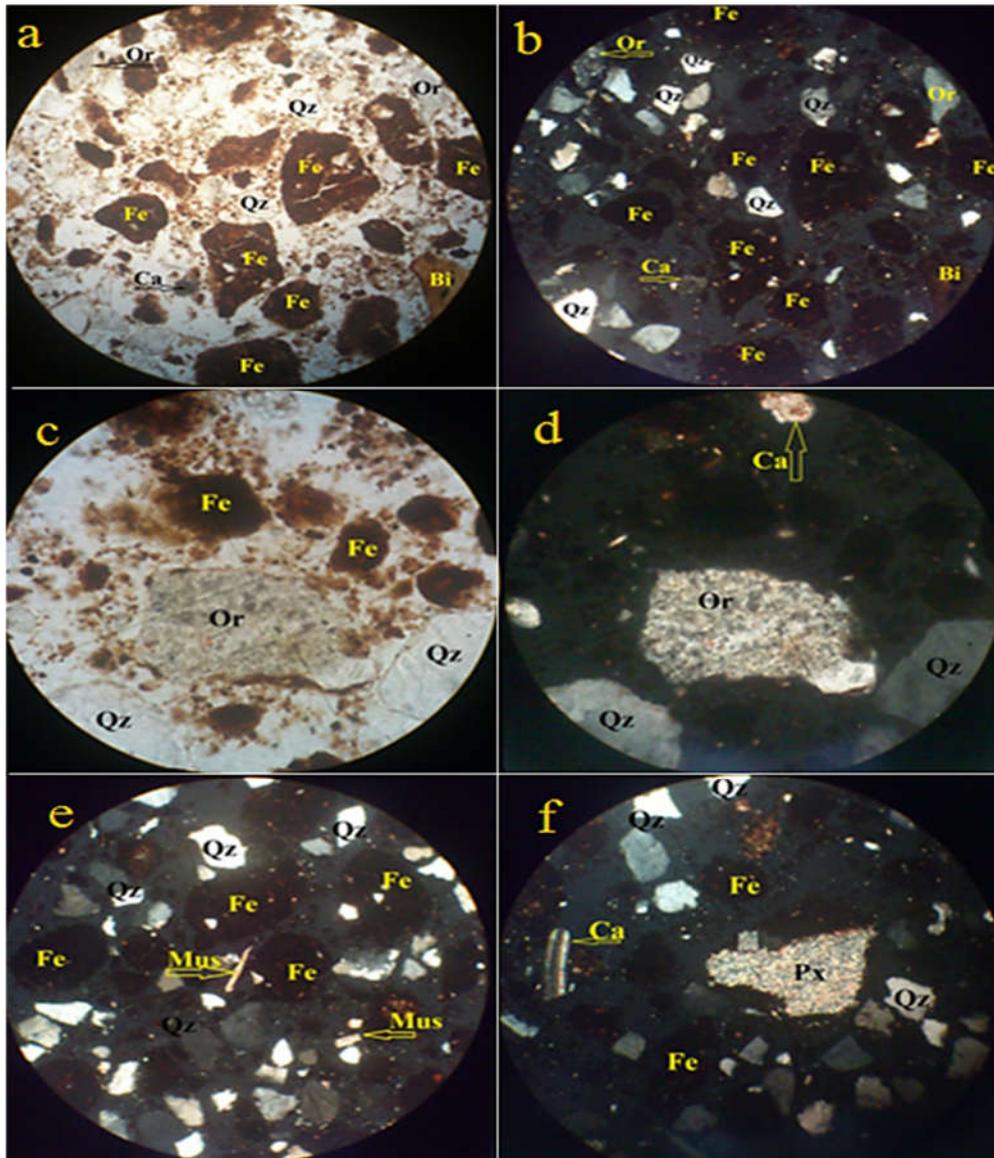


Fig. 3. Suteh PSF sections **a)** Fe component and Quartz in PPL; **b)** Same as a in XPL; **c)** Orthoclase, Quartz and Fe component in PPL; **d)** same as c in XPL; **e)** Fe component, Quartz and Muscovite in XPL; **f.)** Fe component, Quartz, Calcite and Opacity Pyroxene in XPL

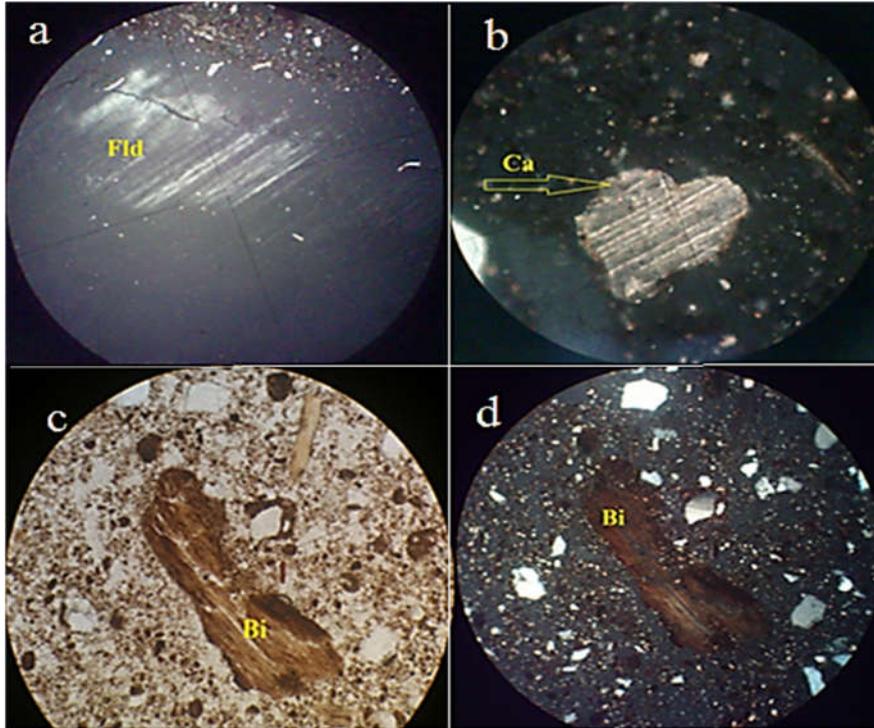


Fig. 4. Suteh PSF sections **a)** Feldspar in XPL; **b)** Calcite in XPL; **c)** Biotite in PPL; **d)** same as c in XPL

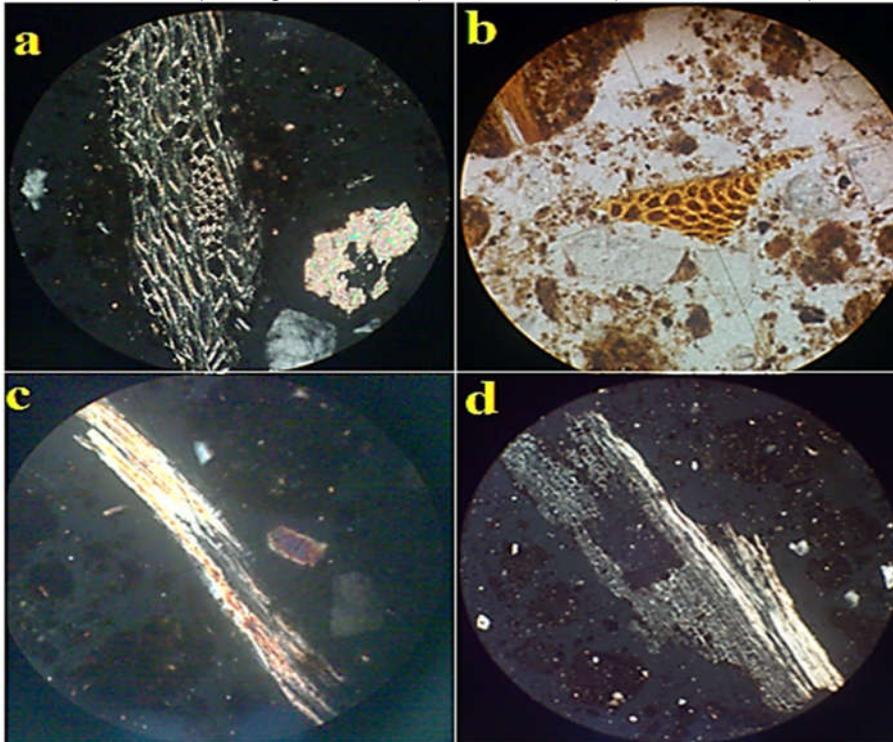


Fig. 5. Suteh PSF sections **a)** Plant tissues and decomposing plant organs in XPL; **b)** Plant tissues and decomposing plant organs stained with iron in PPL; **c)** Mica layers disrupted and stained with iron in PPL; **d)** Organ residues in XPL

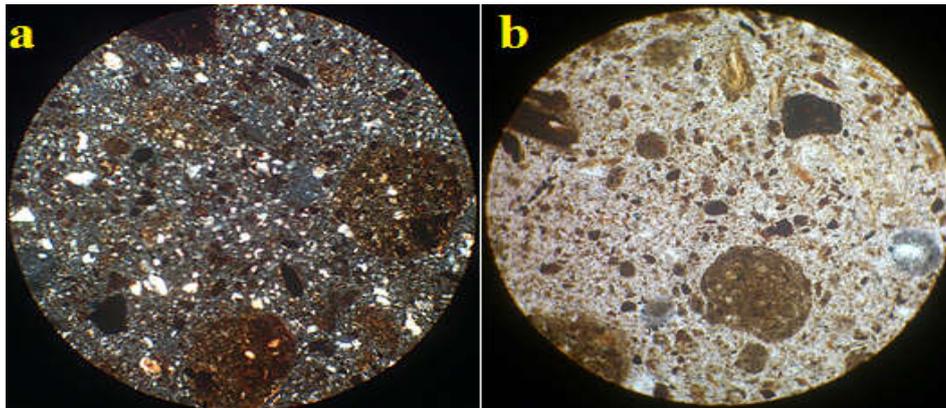


Fig. 6. Ghaleh-ghafeh PS sections a) Fe-Mn component, Quartz and Clay in sericitized background in XPL; b) Same as a, in PPL

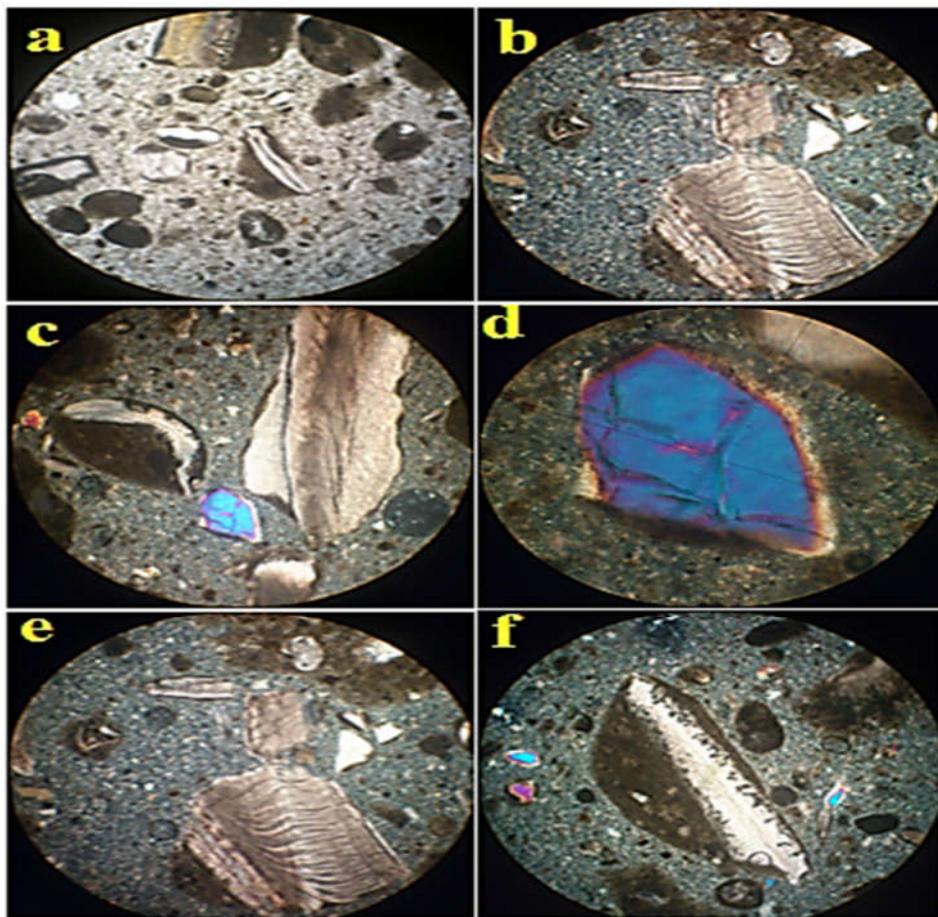


Fig. 7. Galougah CS sections a) Fe component, Oyster or limpet and Quartz in PPL; b) Oyster or limpet in XPL; c) Oyster or limpet and pyroxene in XPL; d) high relief pyroxene in XPL; e) Oyster or limpet and Quartz in XPL; f) same as e.



Discussion

Micromorphological studies of Suteh PSF indicated that the samples have sericitized background with a subhedral granular texture and porphyritic fabric. The most common pedofeatures in Suteh PSF are clay and Fe–Mn nodules, which indicate redox processes, occurring on rock fragments. In a tropical environment, the saprolite is composed of fine-grained quartz and sericitic aligned according to the original schistosity (Stoops et al., 1990). Weathering of the minerals shows the normal stability trend, i.e. quartz > muscovite > biotite. Biotite loses its pleochroism and alters first to a mica-vermiculite interstratified clay mineral (Stoops, 2010). Organic layers in sulphidic soils typically have a high porosity, as deposits composed of a mixture of intact organ residues and amorphous fine organic material (Rabenhorst & Haering, 1989).

Micromorphological studies of Ghaleh-ghafeh PS that the section has sericitized background same as Suteh PSF. The alteration of biotite is expressed by a loss of pleochroism and a decrease of interference colors, indicating transformation to interstratified biotite-vermiculite and iron oxides along cleavage planes or crystal edges (Taboada & García, 1999). In both humid temperate and tropical environments, released iron accumulates as opaque and cryptocrystalline oxides on the edges of the altered biotite or along expanded cleavage planes (Stoops, 2010).

Micromorphological studies of Galougah CS sections examined some inorganic residues of biological origin. Inorganic residues of biological origin include remains of bivalves, such as oyster (Ostreidae), mussel (*Mytilus edulis*) and clam (*Mercenaria mercenaria* and *Mya arenaria*) (Stoops, 2010). In the Galougah CS sections, oyster or limpet exist because of this swamp originally related to Gorgan Gulf and Caspian Sea.

Conclusion

This study focused on micromorphological characteristics of three case studies consisting of soil of a peat swamp forest (**Suteh PSF**), a highland peat swamp (**Ghaleh-ghafeh PS**) and a coastal swamp (**Galougah CS**) in Golestan Province, North of Iran. It is shown that Majority of the minerals are most likely primary minerals inherited from the parent material due to negligible chemical weathering. The soil material of the studied area are composed mainly of quartz, muscovite, biotite, pyroxene, and Fe–Mn component. Most common opaque minerals in samples of all studies area were consisted Fe–Mn component. The occurrence of Fe–Mn nodules showing an accurate boundary indicates mixing of soil material. Micromorphological studies of Suteh PSF

indicated root and other organ residues in some sections that shows this soil composed of a mixture of organ residues and organic material. Micromorphological studies of Galougah CS shown that the sections consist many oyster or limpet with high order interference colors that may be related to location of this swamp near Gorgan Gulf and Caspian Sea.

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