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Evaluation

for the thesis of

Ms. Vera Alexandrovna Korshunova
entitled

**“FORMS OF GOLD AND PATHFINDER ELEMENTS IN LOOSE SEDIMENTS IN
TERRITORIES OF PIILOLA PROSPECTING LICENSE (FINLAND) AND NOVYE
PESKI DEPOSIT (KARELIA REPUBLIC) “**

Submitted for the degree of candidate of sciences in Geology and Mineralogy

Saint-Petersburg, 2021, 133 pages, 60 figures and 16 tables in the English-language version of thesis + 17 pages including 7 figures and 18 tables (CHN analysis, pH, XRD, -ICP-MS data) in the Appendix.

In the current thesis the results of an extensive geological-mineralogical-geochemical investigation of gold and pathfinder elements forms in loose sediments in the territories of the Piilola prospecting license (Eastern Finland) and the Novye Peski deposit (South Karelia), are compiled.

The evaluated mineralogical and geochemical data from the studied material comprises 7 XRD spectra, Rietveld analysis, determination of organic carbon, soil humus content and its fractions (humic, fulvic acids), measurement of pH, particle size fraction analysis in 12+9 samples (Piilola+Novye Peski) of loose sediments representing various horizons of surface sediments, as well as, 57 combined XRF and LA-ICP-MS analyses of gold and pathfinder elements in soil profiles at different horizons.

It also includes chemical phase analyses for 12 samples of loose sediments from Piilola and 9 soil samples from Novye Peski in order to estimate the form of elements.

After an introduction and a comprehensive description of the relevance and purpose of the study, the novelty of the results, methods applied an outline and main statements of the thesis, the Chapter 1 (4 p.) describes the current state of knowledge on the mobility of gold in supergene zones, and methods applied on mobile form analysis.

Chapter 2 (25 p.) deals with a detailed description of the geology of the studied areas, the styles of mineralization present, ore grades, and a mineralogical description of main and minor metallic minerals in the studied deposits, with emphasis on the mode of occurrence of native gold. It also describes the various styles and characteristics of loose sediments (e.g. podzols and moraine) in the studied areas.

Chapter 3 (11 p.) includes results of the Ms Vera Alexandrovna Korshunova's thesis. Starting with a description of the methodology of the work (surface sediments sampling along horizontal and vertical line profiles, and analytical methods used), a subsequent detailed mineralogical and geochemical (e.g. pH, CHN-analysis, total humus content, concentration of HA and FA carbon, and clay minerals distribution) characterization of the individual horizons within the loose sediments in both studied area, ends with their classification. The mineralogy of all examined samples is documented very clearly and is supported by XRD spectra from several samples. It follows an extensive geochemical comparison of gold and several pathfinder element composition of the investigated samples, which have provided important information on their vertical and lateral distribution above and around the ore zones.

Chapter 4 (10 p.) introduces the theory and methodology applied for the sequential extraction of metals(oids) present in various forms in natural systems. The various sequential extraction methods are discussed in detail in the light of the most modern literature and previously published data.

Chapter 5 (27 p.) presents geochemical results of the sequential extraction method used in the thesis, demonstrating (a) the proportion of various forms of elements related to the sum of the element concentrations in all extracts of the sample, as well as the element's mobile form percentage from their total quantity in the horizons of the loose sediments; and (b) the distribution of gold and pathfinder elements in different forms in the surface sediments. This chapter concludes 2 of the 3 statements of the thesis, namely that: water-soluble and bound-to-organic matter forms of Au, and bound to Fe-Mn (hydr-)oxides and to organic matter form of pathfinder elements, have a significant percentage of the total content in the surface sediments and can be used to characterize the elements migration patterns in supergene dispersion halos. Furthermore, the thesis concludes, that the mobile forms of gold and pathfinder elements have different distribution tendencies in the horizons of the surface sediments and the most informative to locate the Au mineralization zone is the eluvial horizon, and for pathfinder elements – the illuvial and the horizon above the bedrock.

Chapter 6 (19 p.) presents geochemical results on the concentrations of chemical elements bound to humic and fulvic acids in the horizons for the loose sediments in both areas and also provides thermodynamic modeling for the processes of Au and As sorption by the solid humic acid. This chapter is together with the previous one the highlight of Ms. Vera Alexandrovna Korshunova's thesis, and concludes, that: Au, Ag, Bi, Ni are bound preferably to humic acid, whereas most of the pathfinder elements bound to fulvic acid. This knowledge is of major importance for the precious metal recovery degree. Interpretations and conclusions of the thesis testify to the author's ability to interpret the results in a scientifically plausible manner, also

based on most modern literature by comparing them with previously published data, and are commendable.

As a whole, the thesis of Ms. Vera Alexandrovna Korshunova's is extensive, rich in valuable results, editorially of very good quality, and an important contribution to the knowledge of the geochemical (and mineralogical) relationships of the percentages of mobile forms of Au and pathfinder elements in loose sediments, their informative horizon, and preferable bound to humic or fulvic acid. All these results contribute to a better understanding of the geochemistry of gold in supergene zones and are valuable for geochemical exploration for gold deposits by secondary dispersion halos in general.

In conclusion, the candidate adequately identified and described the research problem and goal; the candidate is sufficiently acquainted with the appropriate methods and techniques of research; the candidate has sufficient acquaintance with the relevant literature; the candidate has satisfactorily understood the nature of the problem and assessed the significance of the findings; and finally the thesis satisfactorily presented the results of independent research.

Candidate thesis "Forms of Gold and Pathfinder elements in loose sediments in territories of Piilola prospecting license (Finland) and Novye Peski deposit (Karelia Republic) completed by Ms. Vera Alexandrovna Korshunova meets the requirements for candidates with a speciality 25.00.09 — Geochemistry, geochemical methods of prospecting for deposits and candidate Vera Alexandrovna Korshunova deserves the award of the degree of candidate of sciences in Geology and Mineralogy.

Prof. Dr. P. Voudouris

Athens, 4.5.2021

