Geophysical Research Abstracts
Vol. 19, EGU2017-538-2, 2017
EGU General Assembly 2017

Determination of phosphorus in soils and soil extracts by inductively coupled plasma atomic emission spectroscopy (ICP-AES)

Nikolai Sushkov (1,2), Zoya Egorova (1), Olga Rogova (1), Dmitry Volkov (2), and Mikhail Proskurnin (2)

(1) V.V. Dokuchaev Soil Science Institute, Moscow, Russian Federation, (2) Chemistry Department, M.V. Lomonosov Moscow State University, Moscow, Russian Federation

Phosphorus (P) is one of the elements which are essential for all living organisms. Particularly, it is necessary for the nutrition of plants. Its concentration and bioavailability in soils influence the nutrition balance [1]. Therefore, determination of P in soils and in their chemical as well as particle-size fractions is important. Determination usually involves an analysis of soil extracts. This is typically accomplished by a spectrophotometric analysis based on the molybdenum blue colorimetric method [2]. For the last three decades, P determination has been increasingly done by ICP-AES. It is reported that results obtained by the two methods do not always agree well. This could be accounted for, firstly, by possible interference from reagents used for the preparation of extracts, e.g. citrates, and interferences from Si and Fe; and secondly, by the fact that ICP-AES measures total P, whereas molybdenum blue colorimetric method determines orthophosphate only [3]. ICP-AES, as a multi-element technique, also makes it possible to determine P along with many other trace and matrix elements. All this makes ICP-AES preferable for the analysis of soil extracts for phosphorus.

However, soil extracts are often solutions with a high content of salts of alkali metals, up to concentrated brines. This causes non-spectral matrix effects from easily ionisable elements in the ICP which can lead to a considerable skewing of the results [4]. It is therefore necessary to study these effects and to find appropriate conditions for the determination of P by ICP-AES. Some related research does exist in this field [3], but the optimization of the ICP determination stage has been left out of focus.

In this study, we have selected several spectral lines of P and optimized the conditions to achieve the highest signal intensity and signal-to-background ratio. We have applied the matrix matching approach, using 16% NaCl/5% HNO_3 as a diluent in the preparation of all the solutions in order to imitate the matrix of highly saline soil extracts. Analytical performance at the selected P lines has been assessed using the spike-recovery method, and figures of merit calculated. We have investigated non-spectral effects of common matrix elements other than Na (such as Al, Ca, Fe and K). Spectral interferences arising from a number of concomitant elements have also been studied, and the corresponding correction coefficients calculated. Based on these data, we have developed a method for the assessment of P. An analysis of certified reference materials under optimized conditions has shown reasonable accuracy. The obtained results demonstrate the possibility of rapid and reliable ICP-AES determination of phosphorus together with other elements in soils and soil extracts thus eliminating the need in a separate colorimetric experiment.

References

1. Ivanov A.L. (Ed.). Agro-biogeochemical cycle of phosphorus. Moscow: Russian Academy of Agricultural Sciences, 2012 [In Russian].

2. Anschutz, P; Deborde, J., *Limnol. Oceanogr.: Methods*, 2016, 14, 245 — 256.

3. Harrell, D.L.; Wang, J.J., *Soil Science*, 2007, 172 (1), 55 — 67.

4. Todoli, J.L.; Gras, L.; Hernandis, V.; Mora, J., *J. Anal. Atom. Spectrom.*, 2002, 17, 142 — 169.