A09

Auxiliary Results of Collection and Classification of Surface Geoelectric Arrays

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SUMMARY

Recently, we have made a classification of more than one hundred various surface geoelectric arrays ever published in geophysical literature (Szalai and Szarka 2007a, 2007b). The classification is based on three divalent parameters (as “superposition” of measurements, “focusing” of currents and “colinearity” of the array), thus we set up eight groups of geoelectric arrays. One further group was separated for about 10 so-called “composite” arrays, which cannot be classified in the aforementioned way. Here we present some application examples of the classification results. Namely, we call the attention to some hidden relationships among geoelectric arrays: (1) we give an illustration how various arrays can be derived from their root array (besides the Schlumberger-related arrays several other examples will also be given in the presentation); (2) we provide a summary of arrays, capable to measure various partial derivatives of the electric potential. Among the 21 arrays 14 are already published arrays, but there are seven possible, but not-yet-applied arrays. In this way, such missing links in the genealogic trees may lead to creation of reasonable and purposeful new arrays.

INTRODUCTION

The first summary of geoelectric electrode arrays by Whiteley (1973) discussed twenty five geoelectric arrays. In our recent publications (Szalai and Szarka 2007a, 2007b) we collected 92 arrays (including a lot of hardly available arrays from the former Soviet Union), and 10 so-called composite arrays, which could not be put in any of the array groups.

In our systematic classification of geoelectric arrays we apply a unified notation. The classification shows the position of lesser known or not-yet applied electrode arrays in the system of arrays in such a way, as the chemical elements are shown in Mendeleyev's periodic table of elements.

In the presentation, after a brief summary of the proposed classification, at first we show the family tree for two (in the extended abstract: one) basic geoelectric arrays, then a summary is given about arrays, measuring first and second derivatives of the electric potential.

PRINCIPLE OF THE CLASSIFICATION

In the classification both the current and potential electrodes are point electrodes, and all of them are assumed to be on the surface.

The classification of arrays is based on three divalent parameters: a) superposition: if the number of potential difference measurements is more than one, the array is told to be "superposed", otherwise the array is "nonsuperposed"; b) focusing: if more than one current circuits are applied, the array is told to be "focused"; otherwise the array is "nonfocused". c) colinearity: if the alignment of the electrodes is linear, and array is told to be "colinear". Otherwise the array is "noncolinear".

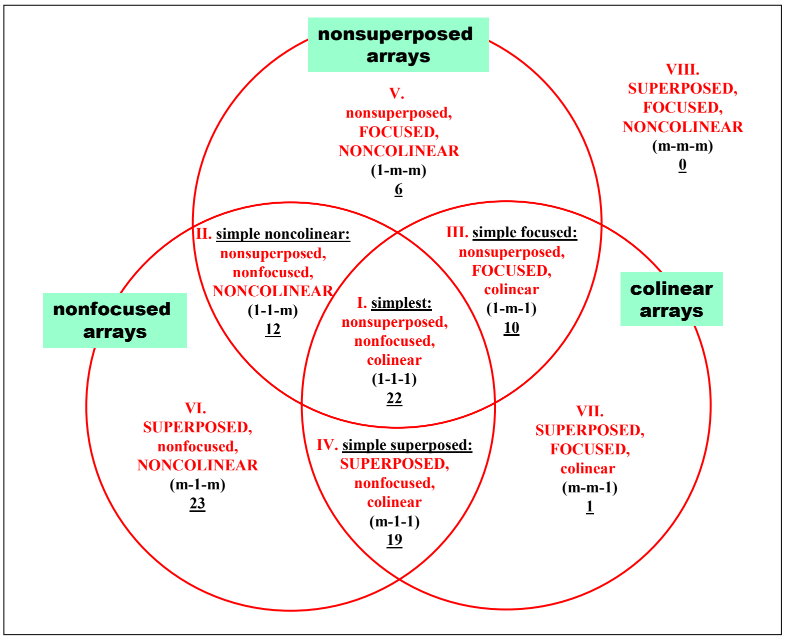

Figure 1: *Classification of surface electrode arrays. Underlined numbers are the numbers of published arrays within a group (after Szalai and Szarka 2007a, 2007b).*

In this way there are altogether $2^3=8$ groups, where the simpler alternative is denoted with "1" and the more complicated one is denoted with "m". The eight groups are shown in Figure 1. Figure 2 is an illustration of one of the groups: the group of the so-called simple superposed arrays. The other groups are published in Szalai and Szarka (2007a).

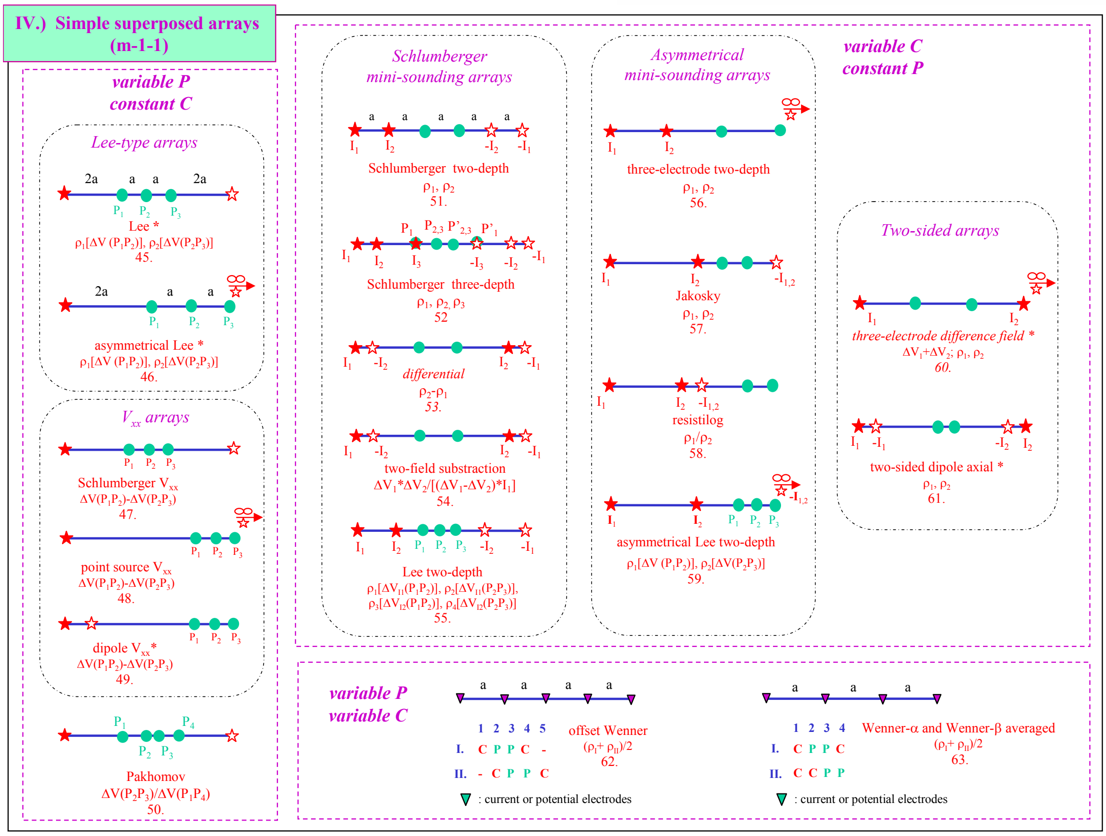

Figure 2: *Simple (nonfocused and colinear) superposed arrays: group IV: m-1-1 (after Szalai and Szarka 2007a).*

FAMILY TREE OF ARRAYS

A lot of arrays occurring in various groups, althought they had been published independently from each other, are not at all independent ones. It can be clearly demonstrated by the family tree of geoelectric arrays. Some of the basic arrays as the Schlumberger array and the dipole axial arrays, eventually the Wenner α and β and the pole-dipole arrays may be regarded as starting points of parent branches. Here we are going to point out, how new and new arrays can be derived from simple Schlumberger array. (In the full version some other parent branches will be also discussed.)

Family tree of the Schlumberger array (Figure 3)

From the basic Schlumberger array (shown as No 1 in Figure 3), in one step it is possible to arrive to several different daughter arrays, as follows.

(a) Increasing the PP distance, we arrive to the Wenner α (No. 2) array, the Palmer (No. 3) arrays, and the No. 4 arrays; (b) Putting one of C electrodes in the infinity we arrive to the pole-dipole array (No. 15); (c) Using the original current electrodes as focusing electrodes we arrive to the unipole Schlumberger array (No. 36); (d) Rotating the line of PP electrodes by 90 degrees, the Schlumberger null array (No. 23) is obtained; (e) Shifting the potential electrodes from their central position we arrive to the Lee array (No. 45); (f) Doubling the CC pair with a smaller CC distance we are at the Schlumberger two depths array (No. 51).

Some of the daughter arrays are sources of further new arrays. The Wenner α and the pole-dipole arrays as starting points of such parent arrays will be discussed in the full version. Members in the step 2 of the Schlumberger family are as follows: (g) From the Schlumberger null (No. 23) array, in one further step, the following arrays are obtained: three electrode null (No. 24) array, Schlumnberger superposed null (No. 73) array and the square-γ (No. 32) array, and athe three-electrode superposed null (No. 74) array is the daughter of array No. 73; (h) From the Lee (No. 45) array the asymmetrical Lee array (No. 46) and the Lee two-depth array

(No. 55) are obtained, and array No. 55 can be easily transformed into tjhe asymmetrical Lee two-depth (No. 59) array; (i) From the Schlumberger two-depth (No. 51) array the Schlumberger three-depth (No. 52) arrays and the differential (No. 53) array can be directly obtained.

The Schumberger family thus involves 18 of the total 92 arrays.

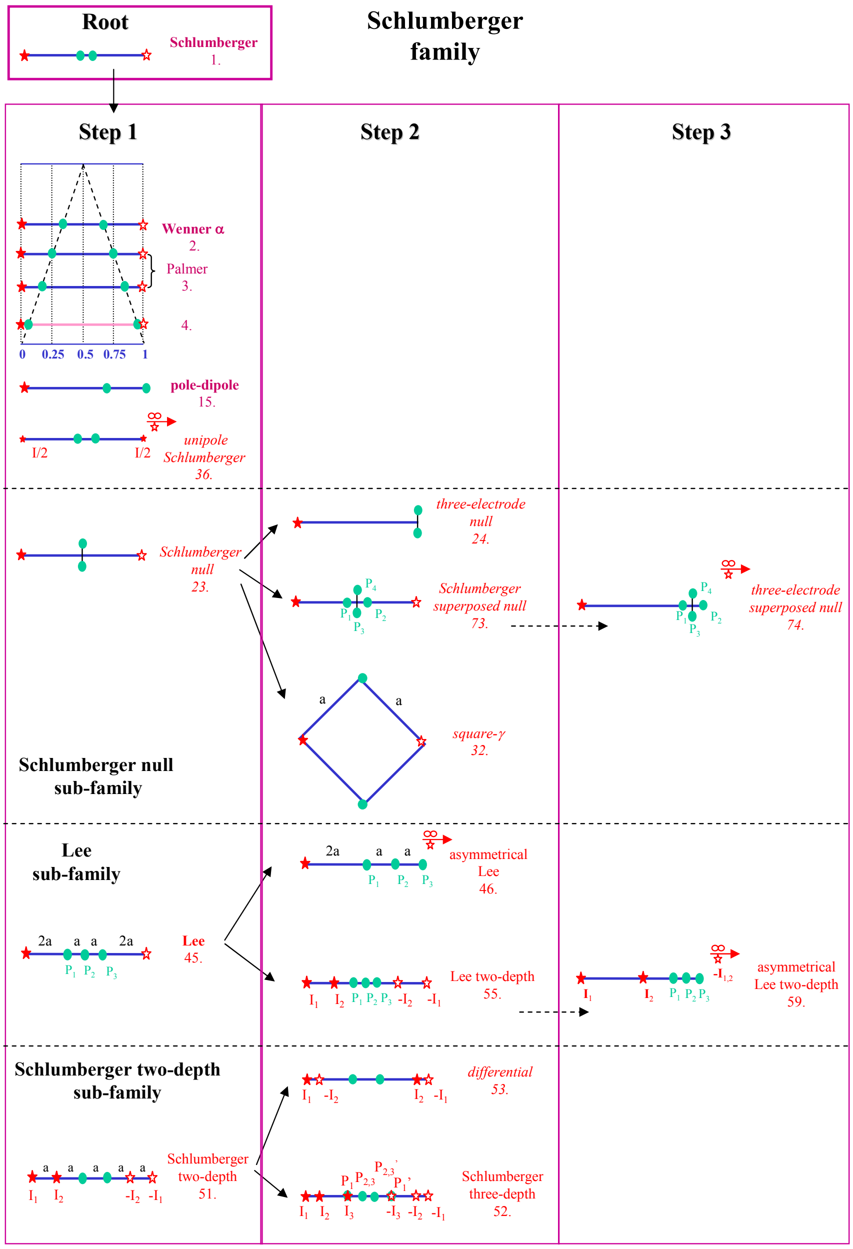

Figure 3: *Family tree of the Schlumberger-related arrays.*

ARRAYS MEASURING POTENTIAL DERIVATIVES

There are a number of smaller array subgroups, as α-, β-, or γ-types, Y-type arrays, null arrays, etc. Such special features could be also used as classification criteria. For example, the null arrays can be completely separated from all other arrays. In the followings we discuss a special selection criteria: how various partial derivatives of the electric potential can be determined. A systematic summary of possible arrays is presented in Figure 4. (A large part of these arrays were published by Sapuzhak, 1967). α- and b-type arrays are used mostly, and among β-type arrays we should distinguish bipole and dipole ones. The zeroth, the first (V_x,

V_y) and the second (V_{xx}, V_{yy}, V_{xy}=V_{yx}) derivatives can be determined by using arrays as shown in Figure 4. Among the 21 arrays 14 are already published arrays, but there are seven possible new arrays. They are realistic, but not-(yet?)-applied in practice.

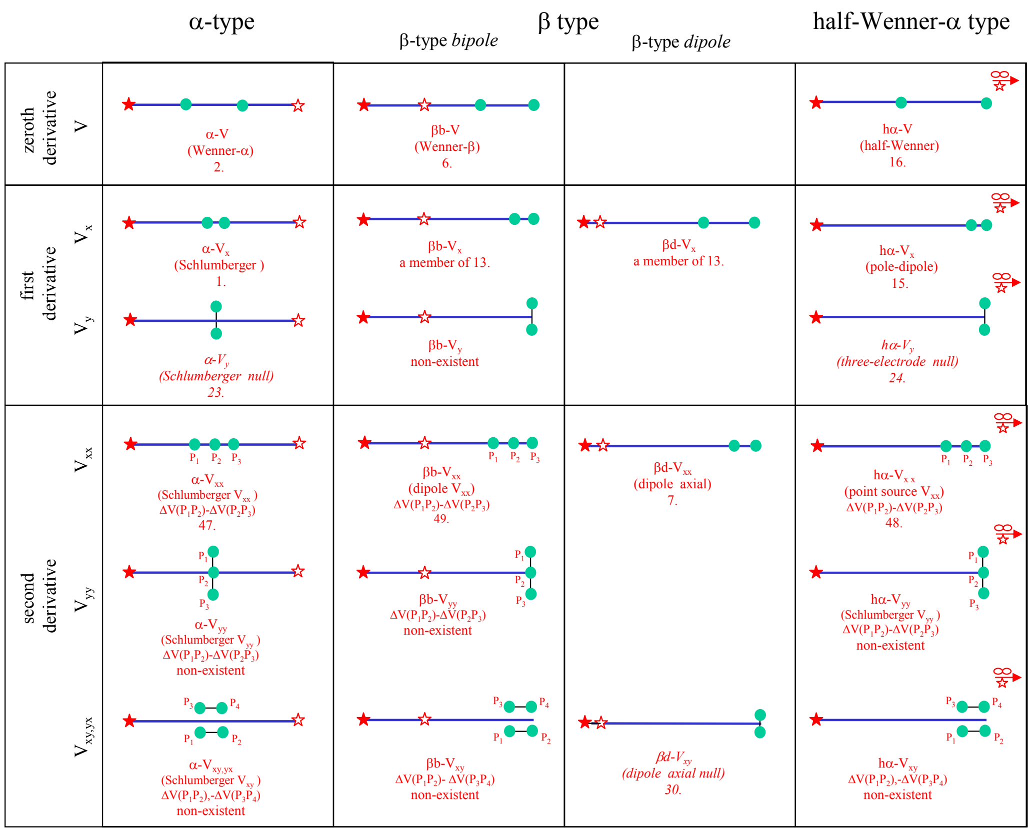

Figure 4: *A systematic collection of arrays, capable to measure various derivatives of the electric potential*

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