Republic, which contained exceptionally large grains of deep violet fluorite identified as antozonite.

MS50-P2 Pattern zoo part I: on the choices and number of asymmetric units for the 17 plane groups

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The 17 plane groups (PGs, often better known as 'wallpaper groups') and related periodic tilings and patterns played – and still play – an important role in arts and cultural history over the centuries. Even in palaeolithic caves, simple patterns and grids (probably for testing pigments) have been found along with the famous cave paintings. Starting with Kepler's *Harmonice Mundi* from 1619, they also form an outstanding object of vivid interdisciplinary research, mainly concentrated in the mathematical sciences.

A basic concept of PGs and tilings is the asymmetric unit (ASU) (or 'fundamental domain', 'generating region'). According to the *International Tables Vol. A*, "An asymmetric unit … is a (simply connected) smallest closed part … from which, by application of all symmetry operations …, the whole of space is filled". It is clear that – except in four PGs – the choice of the ASU, and hence the generated tiling, is not unique. Although this fact is often mentioned in literature, there seem to exist no published enumerations of possible ASUs for the PGs, according to any classification scheme whatsoever.

To enumerate choices of ASUs for the PGs, basic prerequisites are: 1) ASUs (or rather the tile representing an ASU) have to be asymmetric (of course) and by applying symmetry elements the resulting tiling has to fill the plane isohedrally – and thus monohedrally – without overlaps or gaps. From this follows that 2a) mirror planes or rotation axes must not occur inside an ASU; 2b) mirror planes may form edges of an ASU; 2c) rotation axes may occur on corners (all axes) or edges (2-fold axes only) of an ASU; and 2d) glide planes may occur inside ASUs, but their partial lengths underlie restrictions.

In the present attempt to enumerate, but also to limit, the number of possible ASUs, we will adhere to the following further conditions: 1) we will use only convex straight-line bordered polygons as ASU, i.e. 'Escher-like' ASUs are not considered; 2) to assure that the symmetry of a PG is maintained in the resulting tiling, ASUs are graphically marked as asymmetric (the 'zoo mission'); but, we shall allow for 'symmetrized' ASUs, if the unmarked tiling belongs to a smaller cell or to a supergroup within the same crystal system; 3) we will distinguish cell-confined and non-cell-confined ASUs.

Tilings corresponding to all enumerated ASUs of the 17 PGs will be presented graphically, and, where applicable, references to higher symmetric unmarked tilings will be given.