How Does the Smoky Color in Herkimer Diamonds Get There?

The information below is very scientific! Description of the formation of the smoky color in quartz based on the aluminum ion theory is in the link below as well as some discussion of the OH influence.

http://www.quartzpage.de/smoky.html

Another article can be found at **http://www.minsocam.org/ammin/AM71/AM71_1186.pdf**

The aluminum ion theory might well apply to smoky quartz in granitic rocks, but hydrothermal quartz formed in sedimentary rock may require a different theory

Below is a different theory that calls upon an O3 ion (ozonide radical)**.**

NATURAL RADIATION-INDUCED DAMAGE IN QUARTZ. III. A NEW OZONIDE RADICAL IN DRUSY QUARTZ FROM THE ATHABASCA BASIN, SASKATCHEWAN

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Quartz crystals collected in druses, including one annealed at 400°C, from a fracture in the hanging-wall sandstone at the McArthur River uranium deposit in the Paleoproterozoic Athabasca basin, northern Saskatchewan, have been investigated by single-crystal X-band electron paramagnetic resonance (EPR) spectroscopy at room temperature and 110 K. The single-crystal EPR spectra allow us to distinguish eight paramagnetic defects, including one new center and seven previously reported centers. These centers, most of which were discovered in artificially irradiated crystals and only a few had been suggested to occur in natural quartz by powder EPR, are herewith positively established for the first time as natural radiation-induced defects by single-crystal EPR. The new center is similar in principal g-factor values to the ozonide radical (O_3^-) in various minerals and synthetic compounds, and is characterized by its g-maximum and g-minimum axes approximately parallel to two O–O edges of the SiO_4 quasi-tetrahedron in the quartz structure. This geometry is also compatible with an ozonide radical formed from a silicon vacancy. The observed linewidths of the new ozonide radical vary from 0.087 to 0.257 mT, which are attributed to unresolved site-splittings or unresolved hyperfine

splittings. This new ozonide radical is distinct from a previously reported ozonide radical in citrine quartz, which is characterized by the presence of a small ^{27}Al hyperfine structure. The new ozonide radical is probably linked to a Si atom in the neighboring tetrahedron and hence represents a general case in quartz, whereas the previously reported ozonide radical linked to a neighboring Al atom is a special variant in Al-bearing quartz. The presence of natural radiation-induced defects in drusy quartz is attributable to the presence of uranium in mineralized assemblages nearby or late hydrothermal fluids.

It is important to note that in the above article the Aluminum theory is considered as a "special variant" and that the ozonide radical theory is likely more applicable.

Another article below discussing the natural radiation damage of quarts in sedimentary rocks, although not hydrothermal druze.

Applications of Natural Radiation-Induced Paramagnetic Defects in Quartz to Exploration in Sedimentary Basins

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Quartz grains in contact with uranium-bearing minerals or fluids are characterized by natural radiation-induced paramagnetic defects (e. g. , oxygen vacancy centers, silicon vacancy centers, and peroxy radicals), which are amenable to study by electron paramagnetic resonance (EPR) spectroscopy. These natural radiation-induced paramagnetic defects, except for the oxygen vacancy centers, in quartz are concentrated in narrow bands penetrated by α particles: (1) in halos around U- and Th-bearing mineral inclusions and (2) in outer rims or along fractures. The second type of occurrence provides information about uranium mineralization or remobilization (I. E. , sources of uranium, timing of mineralization or remobilization, pathways of uranium-bearing fluids). It can also be used to evaluate sedimentary basins for potential of uranium mineralization. In particular, the peroxy radicals are stable up to 800℃ and, therefore, are useful for evaluating metasedimentary rocks (e. G. , Paleoproterozoic metasedimentary sequences in the central zone of the North China craton). EPR study of the Changcheng Series can focus on quartz from the sediment-basement unconformity and faults to determine the presence and types of natural radiation-induced paramagnetic defects, with which to identify and prioritize uranium anomalies. Other potential applications of natural radiation-induced paramagnetic defects in quartz include uranium-bearing hydrocarbon deposits in sedimentary basins. For example, the Junggar, Ordos, and Tarim basins in northwestern China all contain important oil and natural gas fields and are well known for elevated uranium concentrations, including economic sandstone-hosted uranium deposits. Therefore,systematic studies on the distribution of natural radiation-induced paramagnetic defects in quartz from host sedimentary sequences are expected to provide information about the migration of oil and natural gas in those basins.

For more information look up: natural radiation-induced paramagnetic defects (e. g. , oxygen vacancy centers, silicon vacancy centers, and peroxy radicals).