irradiated gem stones

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Gem stones are those stones which have beauty that can be based on itscolor, transparency, brilliance (degree to which light is scattered) and thecrystalline -perfection (no minerals or other inclusions).Topaz AhSi04(F,OHh. Aluminum fluoro hyd’roxyl-silicate, it belongsto class silicates and subclass cyclosilicates and it is used mainly asgemstones, It is the most common irradiated gem on the market.High energy such as neutrons, have enough energy to produce colorcenters .Irradiation is most often carried out in nuclear reactors (highenergyneutrons). Irradiation of topaz in the Egyptian research reactor(ETRR-2) by neutrons changes its cloudy white color to a reddish pinkwhich could be changed to blue by heating.Nuclear reactions inside the irradiated stones produce radioisotopes.resulting to residual radioactivity. Residual radioactivity is potentially aproblem; therefore stones have to be stored in storage for a period of timeto reduce the residual radioactivity aiming to reach the safety level oftransportation. The storage time of the stones is dependent on traceelement concentrations connected with their life-times in topaz.Therefore, inspection of the trace elements in the stones and their half-lifetimes are essential before irradiation.” -----r--.--._._Trace elements may cause residual radioactivity after neutronirradiation. This undesired residual radioactivity could be detected bytrace element analytical techniques such as Laser Ablation InductivelyCoupled Plasma Mass spectrometer (LA-ICPMS), Energy Dispersive Xrays(EDS), and Neutron Activation Analysis (NAA).Topaz consists mainly of Si02, AhOJ and variable amounts of F andOH group. Raman studies of irradiated and unirradiated stones atdifferent temperatures and irradiation times showed a relation betweenthe bands of scattered peaks corresponding to (OH) stretching modes ofvibration with the color changes.Samples were irradiated using transition pneumatic system (Rabbitsystem) for short time in the range (10-30) second and long irradiation inthe hours range.After irradiation of stones by neutrons, they have to be transefered intothe auxiliary pool until their radioactivity reduces to permissible level,then transfered to hot cells for further treatment.The Egyptian Second Research Reactor, (ETRR-2) is a MultipurposeReactor, (MPR) at Inshas, Cairo Egypt. ETRR-2 is a 22 Mw, an openpool type and maximum thermal neutron flux of 2.7x1014 n cm·2 s’(neutron trap). The reactor is located at Inshas site of the EgyptianAtomic Energy Authority (EAEA) 60 km from Cairo-Egypt.III--- ------.~_ ..The apparatus used in the measurements consists of:- ICP-MS based on double-focusing mass spectrometers (JMSPLASMAX2)is applied for the analysis of topaz samples to investigateminor, trace and ultra trace element concenterations.- Neutron activation analysis (NAA) is

used to determine isotopes in theirradiated samples. NAA is an analytical technique based on themeasurement of characteristic radiation from radio nuclides formeddirectly or indirectly by neutron irradiation of material of interest.- NAA is used to study residual radioactivity in topaz after irradiation.- NAA and radiation protection apparatuses are used to meet InternationalAir Transport Association (IATA) regulations for radioactive mate~~stransfer.- Raman spectrometer is used to explain how coloration process isestablished in gemstones. Raman spectroscopy ’comprises the family ofspectral measurements made on molecular media based on inelasticscattering of monochromatic radiation. During this process, energy isexchanged between the photon and the molecule such that the scatteredphoton is of higher or lower energy than the incident photon. Thedifference in energy is cause of by a change in the rotational andvibrational energy of the molecule and gives information on its energylevels.- ICP-MS and NAAanalyses are compared.IV--~----~’-- ---------- Raman spectrometer is used to study variations in Raman spectra ofdifferent irradiated topaz samples at different times and at differenttemperatures.